

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
Alexandria Division**

VMWARE, INC.,

Plaintiff,

v.

CIRBA INC. (d/b/a DENSIFY),

Defendant.

Civil Action No. _____

JURY TRIAL DEMANDED

COMPLAINT

Plaintiff VMware, Inc. (“VMware”), files this Complaint against Defendant Cirba, Inc. (d/b/a Densify) (“Cirba”) and alleges as follows:

NATURE OF THE ACTION

1. VMware claims that Cirba has infringed and is infringing United States patents that VMware owns: U.S. Patent No. 9,379,995 (the “’995 patent,” Ex. 1); U.S. Patent No. 9,766,945 (the “’945 patent,” Ex. 2); U.S. Patent No. 10,025,638 (the “’638 patent,” Ex. 3); and U.S. Patent No. 10,261,842 (the “’842 patent,” Ex. 4) (collectively, the “Asserted Patents”).

PARTIES

2. VMware is a corporation organized and existing under the laws of the State of Delaware and having its principal place of business in Palo Alto, California. VMware also has a number of regional offices in the United States and throughout the world, including one within this judicial district in Reston, Virginia.

3. Cirba, Inc. is a Canadian privately-owned corporation with a principal place of business located at 400-179 Enterprise Boulevard, Markham, Ontario L6G 0E7, Canada.

JURISDICTION AND VENUE

4. This is a civil action asserting claims of patent infringement of the Asserted Patents. This Court has jurisdiction over this action and VMware's complaint under 28 U.S.C. §§ 1331 and 1338(a).

5. This Court has personal jurisdiction over Cirba. Cirba has purposefully availed itself of the privileges and benefits of the laws of the State of Virginia. Cirba has continuous and systematic business contacts with the State of Virginia and this district. Cirba's Chief Marketing Officer since September 2017, Yama Habibzai, lives in and performs his official and regular duties for and on behalf of Cirba in and from the State of Virginia and this judicial district. On information and belief, in his role as Chief Marketing Officer, Mr. Habibzai markets, directs the marketing of, and supports Cirba's infringing products and services on behalf of Cirba's customers and end-users in the State of Virginia and this district and throughout the United States. Cirba conducts its business throughout the State of Virginia and in this district, by distributing, marketing, offering for sale, selling, and advertising its infringing products and services. On information and belief, Cirba has offered for sale and sold and continues to offer for sale and sell the infringing products and services to developers, partners, and/or customers in this district, including companies and departments and offices of the United States government that are headquartered and/or operate in this district. Cirba has purposefully and voluntarily placed its infringing products and services into this district and into the stream of commerce with the intention and expectation that customers and end-users in this district will purchase and use them in this district. On information and belief, Cirba also knowingly provides support services directly to its customers and end-users in this district to assist with deployment and use of the infringing products and services.

6. Venue is proper in this judicial district pursuant to 28 U.S.C. §§ 1391 and 1400 at least for the same reasons as and because this Court has personal jurisdiction over Cirba. On information and belief, Cirba has offered for sale and sold and continues to offer for sale and sell its infringing products and services in this district. Cirba has committed acts of patent infringement in this district and regularly transacts business within this district.

FACTUAL SUPPORT FOR VMWARE'S CLAIMS

I. VMWARE'S HISTORY OF INNOVATION AND CIRBA'S HISTORY OF INFRINGEMENT

7. Founded in 1998, VMware pioneered the use of virtualization in the data center to consolidate computing workloads. Today, VMware employs over 27,000 in 62 countries, works with over 75,000 partners, and serves over 500,000 customers. VMware has patented its innovations, holding over 2900 U.S. patents.

8. Virtualization technology abstracts a computer's hardware so that computer servers (or "host" computers) can run virtual computers called virtual machines ("VMs"). A VM is software that simulates a physical computer. Multiple VMs can be placed on the same host computer, and software applications run in these VMs rather than directly on the host.

9. VMware was a pioneer in the commercialization of the hypervisor, which is the layer of software residing on a host computer between the operating system and the system hardware that enables virtualization. VMware's hypervisor, formerly known as ESX and now ESXi, provided a base platform (i) for VMware's customers to run their data centers more efficiently by consolidating their workloads into VMs on fewer hosts and (ii) for VMware to build upon, enabling it to reach its position as the global leader in virtualization products, services, and innovation.

10. With its hypervisors running on servers in customers' data centers, VMware also introduced software applications to manage VMs running on top of hypervisors. VMware's VM management application, vCenter, provides a customer the ability to centrally view and manage all the VMs running across all of the hosts in the customer's data center. Innovations in vCenter enabled customers, for example, to create, organize, and prioritize VMs and hosts as well as to allocate VMs across the hosts to achieve more efficient and reliable performance.

11. Cirba was founded in 1999, only a year after VMware, but has always trailed VMware as an innovator. Cirba's products and services interface with VMware's software to provide certain capabilities to customers hosting a VMware environment, and because of this, Cirba's customers and users are first VMware's customers and users. Any success that Cirba has had in the past and has now can be attributed to its infringement of VMware's Asserted Patents. By asserting its patent infringement claims in this action, VMware seeks to end Cirba's infringement.

II. THE '995 PATENT AND CIRBA'S INFRINGING TECHNOLOGY

12. VMware is the owner of all right, title, and interest in and to the '995 patent. The '995 patent was issued on June 28, 2016, and is entitled "Resource allocation diagnosis on distributed computer systems based on resource hierarchy." VMware attaches a copy of the '995 patent as Exhibit 1. The claims of the '995 patent cover methods, systems, and non-transitory machine-readable media for obtaining and analyzing utilization data from a distributed computer system (*e.g.*, a public cloud or virtual environment) and developing allocation recommendations for deployment of available resources.

13. The '995 patent addresses the technological difficulty of applying then "conventional resource allocation techniques," which "make changes with respect to resource allocation in a distributed computer system by manually adjusting low-level controls, such as

shares, limits, and reservations, to manage the resources allocated to” virtual machines and cloud environments. (’995 patent at 1:35-45.) These conventional methods for resource allocation “introduce[] operational overhead” and “can unexpectedly impact the resources delivered to other software clients” in the user’s virtual infrastructure or cloud environment. (’995 patent at 1:39-45.) The ’995 patent describes management of virtual and cloud environments by “monitor[ing] the current usage of resources by the clients, the host computers, . . . and the clusters . . . of host computers” to “implement resource allocation recommendations.” (’995 patent at 6:50-55.)

14. Claim 1 of the ’995 patent recites a method “for performing a resource allocation diagnosis for a distributed computer system.” The steps of the claimed method are:

- “obtaining a target resource allocation and a snapshot of the distributed computer system, wherein the snapshot includes configurations and resource usage information of at least some components of the distributed computer system”;
- “generating a resource allocation recommendation based on the target resource allocation and the snapshot by iteratively traversing a resource hierarchy in the distributed computer system, wherein the resource allocation recommendation specifies at least one resource configuration action or at least one capacity expansion action for the distributed computer system to meet the target resource allocation”; and
- “executing the resource allocation recommendation on the distributed computer system.”

15. Claim 9 of the ’995 patent recites a “non-transitory computer-readable storage medium containing program instructions for performing a resource allocation diagnosis on a distributed computer system, wherein execution of the program instructions by one or more

processors causes the one or more processors to perform steps” corresponding to the steps of claim 1.

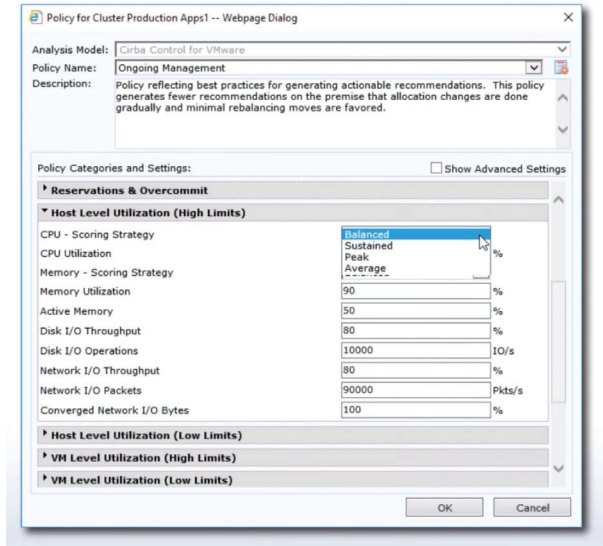
16. The Densify.com SaaS service, which includes the “Real-Time Automation” and “Proactive Automation” features, practices at least claims 1 and 9 of the ’995 patent at least when a customer’s instance of the Densify.com SaaS service implements Proactive Automation or Real-Time Automation (collectively, “Action Automation”) to obtain and analyze utilization statistics to generate and implement recommendations for resource allocation in the customer’s virtual and/or cloud environments.¹

17. The Densify.com SaaS service meets the “obtaining” step of claims 1 and 9. Densify.com SaaS service customers define policies reflecting their management objectives, including target resource allocations. “Policies represent the unique requirements in your environment. You configure the amount of risk that corresponds to your business requirements. You also provide details on your organization’s unique business and operational policies so that requirements for SLAs, regulations, disaster recovery, high availability, etc., are reflected, measured and compliance displayed in the console.”² Densify.com SaaS service customers managing VMware-based environments define policies including target resource allocations such as CPU utilization percentage and memory utilization percentage:³

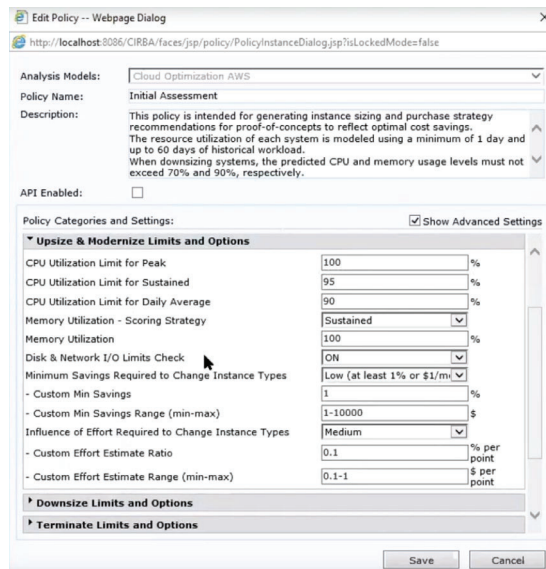
¹ See https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5).

² https://www.densify.com/docs/Content/Control_Console/Understanding_the_Concepts.htm, last visited Oct. 17, 2019 (Ex. 6).

³ *Screenshot from video*, “Viewing Policy Settings,” at 0:14, *available at* https://www.densify.com/docs/Content/Reporting_Framework/Viewing_Policy_Settings.htm, last visited Oct. 17, 2019 (Ex. 7).



18. Likewise, Densify.com SaaS service customers that are managing cloud-based environments, for example, Amazon Web Services (“AWS”), define policies that include CPU allocation limit and memory allocation limit:⁴

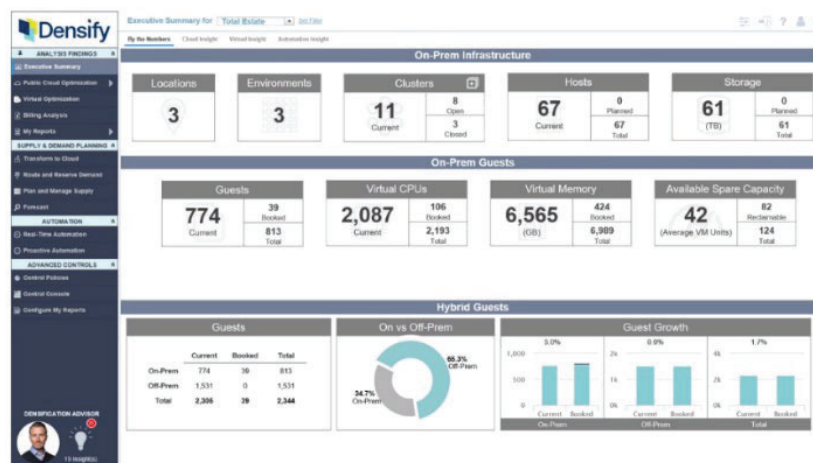


19. Once policies are set, Densify.com SaaS service accesses these policies (*i.e.*, target resource allocations), along with resource utilization data (*i.e.*, a snapshot of the

⁴ Densify, “Densify Analytics & Recommendation Policies,” *YouTube*, (July 8, 2019), at 1:57, available at <https://www.youtube.com/watch>, last visited Oct. 17, 2019.

distributed computer system), to generate its recommendations. “Precise recommendations are derived from policies and operational data to provide IT with unprecedented control over virtual and cloud infrastructure. This control allows you to optimize your environment.”⁵

20. Densify.com SaaS service obtains resource utilization statistics, including instantaneous statistics (*i.e.*, a system snapshot) from, for example, vCenter data via the Densify Connector. “The Densify Connector . . . allows you to perform automated, scheduled data collection from your vCenter Servers and transfer that data via HTTPS to Densify where data analysis is performed. Optionally you can connect to vRealize Operations (vROps) to obtain historical workload data.”⁶ These snapshots from vCenter include resource utilization statistics for at least some computer system components:⁷



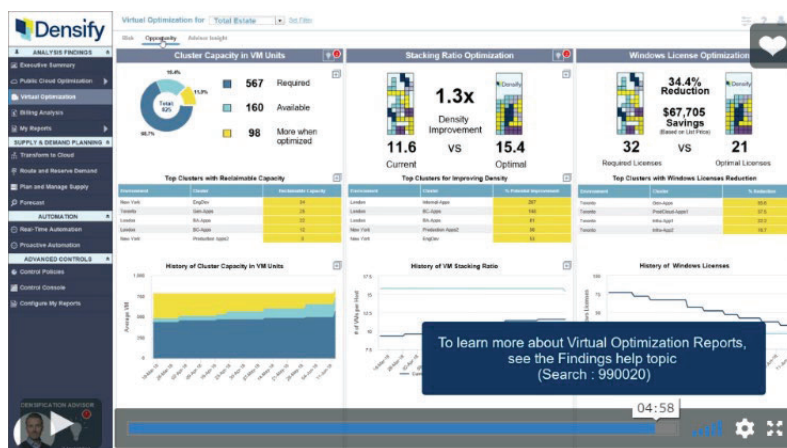
5

https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8).

6

https://www.densify.com/docs/Content/Densify_Com/Data_Collection_VMware_Connector.htm, last visited Oct. 17, 2019 (Ex. 9); *see also* https://www.densify.com/docs/Content/Performing_Data_Collection.htm, last visited Oct. 17, 2019 (Ex. 10).

⁷ Screenshots from video, “Installing the Densify Connector,” at 4:49 & 4:57, available at https://www.densify.com/docs/Content/Densify_Com/Data_Collection_VMware_Connector.htm, last visited Oct. 17, 2019 (Ex. 9).



21. Densify.com SaaS service also obtains resource utilization statistics, including instantaneous statistics (*i.e.*, a system snapshot) from, for example, AWS and other cloud services. When connecting to, for example, AWS, Densify.com SaaS service users initiate a CloudWatch connection to obtain “Resource Utilization Metrics.”⁸ “For example, you can monitor the CPU usage and disk reads and writes of your Amazon EC2 instances.”⁹

22. The Densify.com SaaS service meets the “generating” step of claims 1 and 9. Densify.com SaaS service performs resource allocation analyses to “identify available capacity, risk and optimization and migration opportunities.”¹⁰ “Precise recommendations are derived from policies and operational data to provide IT with unprecedented control over virtual and cloud infrastructure. This control allows you to optimize your environment.”¹¹

⁸

https://www.densify.com/docs/Content/Densify_Com/Using_the_Public_Cloud_Connection_Wizard.htm, last visited Oct. 17, 2019 (Ex. 11).

⁹ <https://docs.aws.amazon.com/AmazonCloudWatch/latest/monitoring/WhatIsCloudWatch.html>, last visited Oct. 17, 2019 (Ex. 12).

¹⁰ <https://www.densify.com/wp-content/uploads/densify-datasheet-saas-model.pdf>, last visited Oct. 17, 2019 (Ex. 13); *see also* <https://www.densify.com/service/on-premises>, last visited Oct. 17, 2019 (Ex. 14) (“Capacity, Control & Visibility: See what you have, what’s coming and exactly what you need—now and in the future.”).

¹¹

https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8).

23. For customers using the Densify.com SaaS service to manage virtual computing environments, “Densify identifies deficiencies in your environment. Deficiencies occur when the current state of a host, VM or sensor-managed resource does not match the associated policy. Recommendations such as correctly sizing VMs, rebalancing workloads to reduce risk, or placing booked workloads that are coming online, are listed in the Spectrum Details pane. The recommendations can be automatically pushed to third party systems such as VMware® vCenter™”¹² These recommendations are displayed by the Densify.com SaaS service’s Control Console feature:¹³



Densify.com SaaS service customers review recommendations for right-sizing their virtual computing environments (*i.e.*, recommendations for resource configuration and capacity

¹² https://www.densify.com/docs/Content/Control_Console/Understanding_the_Concepts.htm (Ex. 6).

¹³ Screenshot from video, “Control Console Overview,” at 2:44, available at https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8) (annotation added).

expansion actions) in reports regarding their environment, including “Bump-Up Recommendations” for adjusting CPU and memory capacity on virtual machines.¹⁴

Environment	Cluster	Guest	Type	From	To	Effective Date
London	Internal-Apps	ali-kpar-8112	Memory Allocation	2,948	4,096	June 27, 2016
London	Internal-Apps	ali-kpar-81234	Memory Allocation	10,240	12,288	June 27, 2016
London	Internal-Apps	ali-kpar-81252	CPU Allocation	1	2	June 27, 2016
London	Internal-Apps	ali-kpar-81252	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-kpar-81624	Memory Allocation	32,768	36,864	June 27, 2016
London	Internal-Apps	ali-kpar-81672	Memory Allocation	4,096	8,192	June 27, 2016
London	Internal-Apps	ali-kpar-81904	Memory Allocation	8,192	12,288	June 27, 2016
London	Internal-Apps	ali-kpar-8592	Memory Allocation	2,948	4,096	June 27, 2016
London	Internal-Apps	ali-kpar-8532	Memory Allocation	2,948	4,096	June 27, 2016
London	Internal-Apps	ali-kpar-8568	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-kpar-8568	Memory Allocation	1,024	2,048	June 27, 2016
London	Internal-Apps	ali-kpar-8628	Memory Allocation	4,096	8,192	June 27, 2016
London	Internal-Apps	ali-kpar-8652	CPU Allocation	2	3	June 27, 2016
London	Internal-Apps	ali-kpar-8652	CPU Reservation	0.2	0.3	June 27, 2016
London	Internal-Apps	ali-kpar-8652	Memory Allocation	11,264	16,384	June 27, 2016
London	Internal-Apps	ali-kpar-8796	CPU Allocation	1	2	June 27, 2016
London	Internal-Apps	ali-kpar-8796	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-kpar-8852	Memory Allocation	4,096	8,192	June 27, 2016
London	Internal-Apps	ali-kpar-888	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-kpar-8904	CPU Allocation	2	3	June 27, 2016
London	Internal-Apps	ali-kpar-8904	CPU Reservation	0.2	0.3	June 27, 2016
London	Internal-Apps	ali-kpar-8904	Memory Allocation	7,168	12,288	June 27, 2016

Similarly, Densify.com SaaS service customers review “Guest Sizing Accuracy” in reports regarding their virtual computing environments for additional recommendations on right-sizing CPU and memory on virtual machines and hosts.¹⁵

Environment	Cluster	Total Guests	Underused Guests	Overused Guests	CPU Allocation (vCPUs)	Memory Allocation (GiB)	Recommendations
London	BA-Apps	122*	28	93	202	1,196	28
London	BC-Apps	79*	6	73	108	604	13
London	Internal-Apps	61*	18	43	258	1,372	22
New York	EngDev	63*	5	58	131	258	34
New York	General Apps	68*	11	57	244	523	27
New York	Production App1	81*	2	79	227	487	19
New York	Production App2	58	2	56	172	310	37
Toronto	Gen-Apps	75	5	70	190	458	37
Toronto	Infra App1	74	5	69	240	511	17
Toronto	Infra App2	47	2	45	165	355	7
Toronto	ProdCloud App1	46	3	43	150	485	22
Total		774	99	675	2,087	6,478	262

Resource allocation requirements for Guests are based on the control policy settings of the virtual environment in which they reside. Systems are classified to be Underused if the requirement for one or more resources (CPU or memory or disk) is more than the existing allocation. Systems are classified to be Overused if the system is not at full and the requirement for one or more resources (CPU or memory or disk) is less than the existing allocation. *80 systems in these clusters are classified as both Underused and Overused.

¹⁴ Screenshot from video, “De-Risk Report Overview,” at 6:25, available at https://www.densify.com/docs/Content/Reporting_Framework/De-Risking_Your_Environment.htm, last visited Oct. 17, 2019 (Ex. 15).

¹⁵ Screenshot from video, “Guest Sizing Accuracy Report Overview,” at 2:34, available at https://www.densify.com/docs/Content/Densify_Com/Guest_Sizing_Accuracy_Reports.htm, last visited Oct. 18, 2019 (Ex. 16).

24. For customers using Densify.com SaaS service to manage public cloud computing environments, right-sizing recommendations are viewed in the “Recommendations Filter Menu,” which includes right-sizing recommendations for vCPU and memory, for example, for each of the customer’s AWS instances:¹⁶

Densify

Public Cloud Optimization for AWS

Guest Filters: AWS Account All Business Unit All Application All Owner All Set More Filters Apply Reset

EC2 EBS Auto Scaling Groups Reserved Instances Spot Instances Bidflex Insights

Optimization Strategy Optimize Instance Type & Optimize Purchasing Strategy Sort by Overall Status & Optimization Type 664 instances \$18,738 Savings/Month

Overall Status

Savings Opportunity

Identified Risk

Optimization Type

Terminable

Non-Terminable

Modestly - Optimal Family

Discontinue

Downsized - Optimal Family

Low Right

Optimal

Optimal - Optimal Family

Purchasing Strategy

Reserved

On Demand

Spot (Predictable Cost)

Effort Required

None

Very Low

Low

Medium

High

Impact

Monthly Savings

Adverse Outcome

Service Characteristics

Predicted Instance

Adverse Outcome

Apply Reset

Optimization Strategy	On Demand	Reserved	Recommended	Avg. Predicted Update (%)	Current ID Coverage (%)	Estimated Cost (\$)	\$ Savings/Month	E-Res	CPU Allocation (vCPUs)	Memory Allocation (GB)	Current	Recommended	Current	Recommended	RI Impact	
Optimization Type	33.87	19.58	-	62.7	0	56.01	-	56.01	Low	2	-	-	4.2	-	-	
Purchasing Strategy	4.23	2.42	-	78.9	0	6.68	-	6.68	Low	1	-	-	0.5	-	-	
Effort Required	16.79	9.83	-	89.4	0	13.51	-	13.51	Low	1	-	-	2.1	-	-	
Impact	8.47	4.92	-	99.2	0	8.41	-	8.41	Low	1	-	-	1.1	-	-	
Service Characteristics	67.74	-1.00	-	100	0	67.74	-	67.74	Low	2	-	-	8.6	-	-	
Reserved	485.45	257.50	228.33	89.7	0	3,132.90	1,626.64	1,506.26	Low	8	8	65.5	65.5	-	Neutral	
On Demand	121.18	64.33	57.08	83.7	0	405.88	228.32	177.56	Low	2	2	16.4	16.4	-	Neutral	
Spot (Predictable Cost)	243.09	128.75	114.17	79.8	0	775.63	456.68	318.95	Low	4	4	32.8	32.8	-	Neutral	
n-Demand	146.00	84.42	140.16	91.7	0	401.76	385.69	15.07	Low	4	4	17.1	17.1	-	Neutral	
n-Demand	73.00	42.25	70.00	93.2	0	136.06	130.62	5.44	Low	2	2	8.6	8.6	-	Neutral	
n-Demand	73.00	42.92	38.50	82.6	0	120.67	73.00	47.67	Low	2	2	4	4	-	Neutral	
n-Demand	73.00	-1.00	62.05	89.9	0	59.09	56.23	8.86	Low	2	2	4	4	-	Neutral	
Monthly Savings	292.00	168.83	280.32	57.3	0	167.29	160.60	6.69	Low	8	8	34.4	34.4	-	Neutral	
Adverse Outcome	146.00	84.42	83.58	99.8	0	145.45	83.58	61.87	Low	4	4	17.1	17.1	-	Neutral	
Terminable	48.91	29.42	19.58	81.1	0	1,110.46	548.24	562.22	Moderate	1	2	4	4	-	Neutral	
Non-Terminable	48.91	29.42	33.87	80.4	0	472.12	326.94	145.18	Moderate	1	2	4	4	-	Neutral	
Predicted Instance	n-Demand	146.00	-1.00	70.00	91.2	0	133.08	63.88	69.20	Low	4	2	17.1	8.6	-	Neutral
Adverse Outcome	Reserved	146.00	84.42	57.08	81.6	0	7,033.18	3,367.72	3,865.46	Low	4	2	17.1	16.4	-	Neutral
	n-Demand	73.00	42.92	33.87	89.7	0	785.83	364.60	421.23	Moderate	2	2	4	4	-	Favorable
	Reserved	145.27	86.58	42.25	88.6	0	819.72	295.75	523.97	Low	4	2	8	8.6	-	Neutral

Additional actions are recommended and displayed in “Cloud Optimization Reports”:¹⁷

¹⁶ Screenshot from video, “Using the Recommendation Filter,” at 2:08, available at https://www.densify.com/docs/Content/Densify_Com/Using_the_Filter_Menu.htm, last visited Oct. 17, 2019 (Ex. 17) (annotations added).

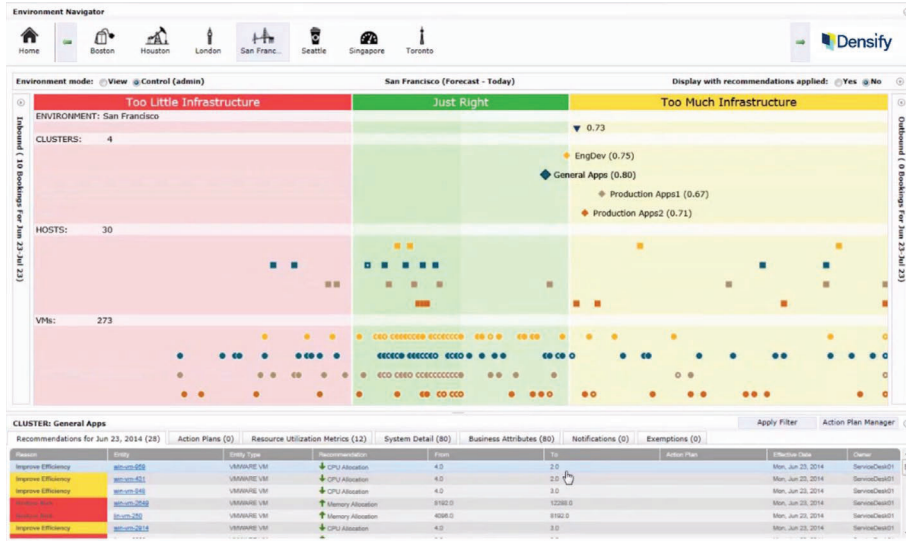
¹⁷

https://www.densify.com/docs/Content/Densify_Com/Viewing_Cloud_Optimization_Reports.htm, last visited Oct. 17, 2019 (Ex. 18).

Optimization Type	Description
Just Right	This instance is optimally sized for the workload.
Upsize Recommendations	In general upsize recommendations incur additional costs. The cost increase is determined by comparing on-demand pricing. The increased cost is required to alleviate application risk. It is possible that if you have an RI for the recommended upsize instance, there could be cost savings. This would still be an upsize recommendation.
Upsize - Optimal Family	This instance should be upsized to a more optimal instance family. This will improve the workload's performance and reduce risk. If the workload can be moved to larger instance in a different family and still reduce cost, this then becomes a Modernize recommendation.
Upsize	This instance should be upsized to an instance within the same instance family. The hosted workload needs an instance with more CPU and/or memory resources. e.g. r3.large to r4.xlarge, both are in the "Memory Optimized r" instance family.
Upscale	This recommendation applies to ASGs only and indicates the ASG needs increase compute capacity by adjusting the maximum group size. It may be more cost effective to use a larger instance for this ASG.
Terminate & Downsize Recommendations	Downsize recommendations reduce the allocated resources as your workload has likely been over-provisioned. Once the recommendation has been determined from CPU and memory utilization it is then further verified against policy-defined limits. Before the downsize or terminate recommendations are made.
Terminate	This instance should be terminated, as it is idle. An instance is determined to be idle if it has very low CPU utilization, network and disk I/O over an extended period of time. This will save you money.
Downsize - Optimal Family	This instance should be downsized to an instance belonging to an instance family that more closely suits your workload's utilization. When you downsize, CPU and/or memory will be decreased to better suit your workloads. Utilization will improve with no impact on performance. This will save you money.
Downsize	This instance should be downsized to an instance within the same instance family. As indicated above, CPU and/or memory will be decreased to better suit your workloads. Utilization will improve with no impact on performance. This will save you money.
Downscale	This Auto Scaling group should be downscaled to decrease the compute capacity by adjusting the minimum group size.
Modernize Recommendations	Modernize recommendations move your workload to a more modern instance type without changing the resource allocation, cost or performance, at a minimum. Your costs could decrease and/or you may benefit from potential utilization and performance improvements.
Modernize - Optimal Family	This instance should be modernized to an instance belonging to a more optimal instance family. The cost of the new instance type will be less than the existing cost. Allocated resources are not being removed and moving to an instance with more current hardware, you may also benefit potential utilization and performance improvements. When you modernize, you will not decrease performance but will decrease cost.
Modernize	This instance should be modernized to an instance within the same instance family. The cost of the new instance type will be less than the existing cost and as indicated above you may also get utilization and performance improvements. For example, moving to a new generation of the same instance family (e.g. m3.large to m4.large).

25. Upon information and belief, the Densify.com SaaS service iteratively traverses a resource hierarchy to generate its recommended actions. Conventional methods for generating “best fit” recommendations of prioritized lists require iteratively traversing the prioritization hierarchy to generate a best fit. For instance, Densify.com SaaS service necessarily considers clusters, hosts, and virtual machines in a virtual computing environment when it generates recommendations for changes to the environment and, depending on user policy, prioritizes for resource allocation (*i.e.*, necessitates iteratively traversing a resource hierarchy):¹⁸

¹⁸ Screenshot from video, “Control Console Overview,” at 2:44, available at https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8).



Upon information and belief, Densify.com SaaS service performs a “best fit” recommendation analysis when generating cloud optimization recommendations, like it does when generating virtual computing environment optimization recommendations:¹⁹

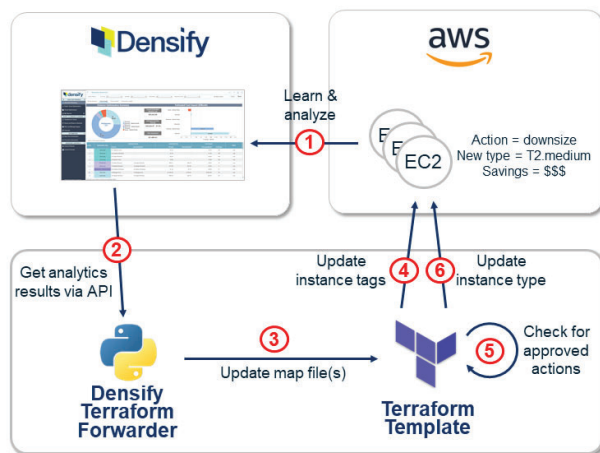
The screenshot shows the 'Public Cloud Optimization for AWS' dashboard. It features a table with columns for 'Costs', 'Overall Status', 'Optimization Type', 'Current', 'Recommended', 'Recommended Purchasing Strategy', 'Per Instance Cost (\$)', 'Avg. Predicted Uptime (%)', 'Current % Coverage (%)', 'Estimated Cost (\$)', and 'Savings/Month'. The table lists various AWS instances and their optimization recommendations. A summary at the top right indicates '664 instances' and '\$13,278 Savings/Month'. A footer note states: 'Currently there are a total of 664 instances. Estimated Cost is based on the Instance Cost, Predicted Uptime and RI Coverage if applicable. RI Price is based on "Reserved Pricing Option" in the Policy.'

26. The Densify.com SaaS service meets the “executing” step of claims 1 and 9. For Densify.com SaaS service customers managing virtual computing environments, “Densify Connector, via a PowerShell script connects to the vCenter Server and using standard VMware

¹⁹ Screenshot from video, “Viewing the Cloud Optimization Dashboard,” at 2:16, available at https://www.densify.com/docs/Content/Reporting_Framework/Viewing_the_Optimization_Overview_Report.htm, last visited Oct. 17, 2019 (Ex. 19).

CLI calls, applies the recommendations.”²⁰ Likewise, “the Densify Connector, via a PowerShell script, connects to the vCenter Server and using standard vCenter API calls, applies the recommendations.”²¹

27. For Densify.com SaaS service customers managing cloud computing environments, such as AWS, Densify sends instructions implementing its recommendations using the Densify Terraform Forwarder and Terraform Templates:²²



After “perform[ing] data collection and analysis” and “obtain[ing] results of Densify analytics,” Densify.com SaaS service’s “Terraform Forwarder generates a Terraform map file with the Densify analysis results and recommendations. This includes an approval code that optionally enables full automation. . . . Densify analysis results are found within the Terraform template

²⁰ https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5); *see also* Press Release, “Cirba Adds Intelligence to VMware® VSphere® DRS to Combine Software-Defined Control with Real Time Response,” (Aug. 27, 2015) *available at* <https://www.densify.com/company/news/releases/20150827-vmware-vsphere-drs-software-defined-control-real-time-response> (Ex. 20).

²¹ https://www.densify.com/docs/Content/Densify_Com/Using_Real-Time_Automation.htm, last visited Oct. 17, 2019 (Ex. 21).

²² https://www.densify.com/docs/Content/Densify_Com/Enabling_Self-Aware_Self-Optimizing_Instances.htm, last visited Oct. 18, 2019 (Ex. 22).

and are then automatically placed into tags in the specified cloud instance . . . [and a] single line of code is added to enable the instance to optimize itself based on the Densify analysis results.”²³

28. Accordingly, the Densify SaaS service directly infringes at least claims 1 and 9 of the ’995 patent.

29. Cirba has known of the ’995 patent at least since VMware filed this Complaint. Moreover, the United States Patent and Trademark Office cited U.S. Patent Application Publication No. 2016/0098297, which is the publication of the application from which the ’995 patent was issued, during the prosecution of Cirba U.S. Patent Application No. 14/967,694 on February 9, 2017.

30. Cirba has actively encouraged and instructed, is actively encouraging and instructing, and will continue to actively encourage and instruct its customers and users to implement and use the Densify.com SaaS service. Cirba’s technical and marketing materials (including videos) on the Internet, cited above, memorialize this active encouragement and instruction.

31. Cirba’s technical and marketing materials support and market Densify.com SaaS service, instructing customers and users on its use in a manner that practices at least claims 1 and 9 of the ’995 patent as discussed above by generating and executing recommendations for resource allocation in a customer’s virtual and cloud environments based on utilization data obtained from those environments.²⁴

²³ *Id.*

²⁴ See https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5.)

32. Cirba directs, instructs, and encourages its customers and users to implement Cirba's Densify.com SaaS service, including its Action Automation and Terraform-based features.

33. Cirba's past, present, and future acts of encouraging and instructing customers to use the Densify.com SaaS service and its Action Automation and Terraform-based features has induced, induces, and will continue to induce their practice of at least claims 1 and 9 of the '995 patent.

III. THE '945 PATENT AND CIRBA'S INFRINGING TECHNOLOGY

34. VMware is the owner of all right, title, and interest in and to the '945 patent. The '945 patent was issued on September 19, 2017, and is entitled "Virtual resource scheduling for containers with migration." VMware attaches a copy of the '945 patent as Exhibit 2. The claims of the '945 patent cover methods, systems, and computer readable media for managing and scheduling resources available to virtual machines and containers.

35. The '945 patent addresses "[c]ontainerization technology" and the "complexity" of "resource optimization and tuning for performance gain" introduced by "containers hosted on virtual machines." (*See* '945 patent at 1:18-35.) The '945 patent teaches that "[i]n a virtual infrastructure hosting containers, embodiments described herein optimize hardware resources by providing a correct resource allocation to host VMs by looking at the consumption of containers. Ideal placement of host VMs in a server farm allows for better consolidation." ('945 patent at 4:7-11.) Thus, embodiments of the claimed methods, systems, and computer readable media "reduce wastage of underlying physical resources in a datacenter." ('945 patent at 2:12-13.)

36. Claim 1 of the '945 patent recites a "method for scheduling computing resources." The steps of the claimed method are:

- “determining a resource availability for one or more hosts, a resource allocation for one or more virtual machines (VMs), and a resource usage for one or more containers”;
- “identifying the one or more hosts on which VMs and containers can be consolidated based on the resource availability”;
- “calculating a target resource configuration for one or more VMs”;
- “removing or adding resources to each of the one or more VMs for which a target resource configuration was calculated to achieve the target resource configuration for each VM”;
- “allocating the one or more VMs on the one or more hosts based on the resource availability of the one or more hosts”; and
- “allocating the one or more containers to be executed in the one or more VMs based on the resource configuration of each VM and the resource usage of each container.”

37. Claim 8 of the '945 patent recites a “non-transitory computer readable storage medium containing a program which, when executed by one or more processors, performs operations for scheduling computing resources, the operations” corresponding to the steps of claim 1. Claim 15 of the '945 patent recites a “system, comprising: a processor; and a memory, wherein the memory includes a program executable in the processor to perform operations for scheduling computing resources, the operations” corresponding to the steps of claim 1.

38. The Densify.com SaaS service practices at least claims 1, 8, and 15 of the '945 patent by managing and scheduling computing resources for virtual machines and containers using, for example, its “Real-Time Automation” and “Proactive Automation” features.

39. The Densify.com SaaS service meets the “determining” step of claims 1, 8, and 15. For example, the Densify.com SaaS service determines VM and host resource utilization statistics, including current resource utilization statistics from vCenter and past resource utilization statistics from vROps, through the Densify Connector associated with a customer’s data center. “The Densify Connector is a self-contained, Windows-based application. It allows you to perform automated, scheduled data collection from your vCenter Servers and transfer that data via HTTPS to Densify where data analysis is performed. Optionally you can connect to vRealize Operations (vROps) to obtain historical workload data.”²⁵ Cirba’s Control Console also receives resource utilization statistics (*i.e.*, what new workloads are coming into the system) from Cirba’s Reservation Console, introduced in 2013.²⁶ And Densify.com SaaS service accesses its own historical database of past resource utilization statistics previously accessed using a Densify Connector.²⁷

40. Cirba touts Densify.com SaaS service’s application demand management. According to Cirba, Densify.com SaaS service “is the only solution that enables organizations to actively balance capacity supply with application demand by providing complete visibility into server, storage and network capacity based on both existing and future workload requirements. . . . No other solution can model all the critical factors that impact resource requirements such as

²⁵

https://www.densify.com/docs/Content/Densify_Com/Data_Collection_VMware_Connector.htm, last visited Oct. 17, 2019 (Ex. 9).

²⁶ “How Cirba Works with Andrew Hillier,” *Vimeo* at 43:47 (Nov. 18, 2015), *available at* <https://vimeo.com/146181163>.

²⁷

Video, “Installing the Densify Connector,” at 1:55, *available at* https://www.densify.com/docs/Content/Densify_Com/Data_Collection_VMware_Connector.htm, last visited Oct. 17, 2019 (Ex. 9) (noting that Densify.com SaaS, via Densify Connector, can develop its own database of historical data if historical data is not available through its connection to VMware (*e.g.*, from vROps)).

service levels, compliance rules, redundancy and the unique workload patterns of each application. Without the ability to account for these factors, and also model the pipeline of inbound application demands, organizations rely on estimates or best guesses to manage their hosting environments, resulting in over-provisioning and increased risk.”²⁸

41. Densify.com SaaS service likewise determines the resource availability for hosts and resource utilization of containers in the customer’s computing environment. “Once the container resource allocations are aligned with actual consumption, Densify will also optimize the nodes the containers are running on in order to make sure the underlying resources are consistent with workload demands. This process is supported for both on-prem nodes as well as cloud-based deployments.”²⁹ “Cloud-based container deployments are typically hosted on top of scalable node groups, such as AWS’ Auto Scaling groups (ASGs). In these deployments, the types of nodes may not match the actual work being done, and Densify will generate recommendations to change the nodes to match the workload. For example, some container workloads may be memory intensive, and running them in a general-purpose instance type may be less efficient than running them in a memory optimized or burstable instance. Densify will also recommend different min and max values for the group based on the workload patterns. This will often shave 30% or more of the cost of the nodes in use, and improve elasticity and app performance.”³⁰

²⁸ Press Release, “Cirba Now Provides Business and Application-Centric Control of IT Infrastructure Supply and Demand,” (Apr. 18, 2014), *available at* <https://www.densify.com/company/news/releases/20140428-application-centric-control-it-infrastructure-supply-demand> (Ex. 23).

²⁹ <https://www.densify.com/service/technologies/container-optimization>, last visited Oct. 17, 2019 (Ex. 24).

³⁰ *Id.*

42. Densify.com SaaS service performs these resource analyses on hosts, VMs, and containers simultaneously. “Because on-prem nodes [*i.e.*, virtual data centers] are not as elastic as cloud infrastructure, the focus is typically to ensure there is sufficient capacity to meet peak requirements, and if the nodes are virtual machines, to ensure the container workloads are optimized within the broader context, providing the optimal workload density. In this context, Densify is able to analyze several critical factors that impact container operation:

- Cumulative resource allocations
- Actual utilization and contention probability
- Service tiering and fit-for-purpose clusters
- Managing overlapping quotas (“double overcommit”)³¹

43. The Densify.com SaaS service meets the “identifying” step of claims 1, 8, and 15. Densify.com SaaS service identifies the one or more hosts onto which VMs and containers can be consolidated based on the resource availability:³²

³¹ *Id.*

³² *Screenshot from video*, Densify, “Cloud Optimization Done For You,” *YouTube* at 3:36 (Aug. 23, 2017), *available at* https://youtu.be/K8L7Ne2a_o8 (describing predictive and proactive resource management) (annotation added).

Key outcomes



De-risks infrastructure

- Predictive analytics anticipates capacity risk and proactively places workloads and allocates resources to avoid capacity shortfalls, reducing motioning and avoid performance issues

Reduces costs of infrastructure

- Intelligent workload stacking and resource allocation increases density by an average of 48%, reduces hardware needs by an average of 33%, reduces software licensing by an average of 55%, and reduces cloud spend by 20-80%

Automates workload placement & resource optimization

- Automated analysis of supply and demand provides proactive, transparent management of VM placements and resource allocations, automated routing of new applications, and detailed capacity measurement and reporting

Transforms workloads onto new hosting models

- Provides precise, data-driven Public cloud migration analysis, bare metal workload stacking, container analysis or justification to stay on-prem



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44. Describing Densify.com SaaS service's Control Console, Andrew Hillier, Cirba's CTO, provided an exemplary case of VM management, including host identification: "This is a clear case of imbalance. I need to move VMs between these hosts to balance this out . . . [Cirba's software] will sort all these out and it will do it predictively, so you can tell a policy, that may not have happened yet, that may be at high risk of happening if you look at the patterns of what is running on it . . . based on the VMs that are on this host, you have a high risk of that happening, so we're going to take care of it before it even happens. . . . So we will find a whole lot of stuff that DRS won't find . . . Even this case, this would probably be a case where that may not have happened yet, we're just saying the likelihood of it happening based on the model . . . this is a predictive model based on the past, so this might go back . . . through three months and build an envelope of what the utilization pattern looks like and say 'yeah, we're looking like we're at risk'." ³³

³³ "How Cirba Works with Andrew Hillier," *Vimeo*, at 29:59-31:00 (Nov. 18, 2015), *available at* <https://vimeo.com/146181163>.

45. Densify.com SaaS service also identifies appropriate host placements for containers:

Densify also performs performance optimization at the node-level, and by optimizing the node types to match the workload demands, containers can be assured the optimal CPU, memory and I/O resources based on their needs. But optimization goes far beyond this—as organizations grow their container footprints they will often set up different cluster configurations with different design points or service tiers, making them “fit for purpose” for different types of workloads. For example, it may make sense to set up ‘CPU intensive’ and ‘Memory Intensive’ clusters, and route workloads into them based on their resource needs.

It is even possible to analyze an application’s sensitivity to different resource types, like more cores vs larger cores, further optimizing the performance of each application. Densify enables these parameters to be scientifically controlled, and uses performance benchmarks to automatically normalize data between different CPU architectures, enabling predictive models to be correlated with reality in order to optimize app performance.³⁴

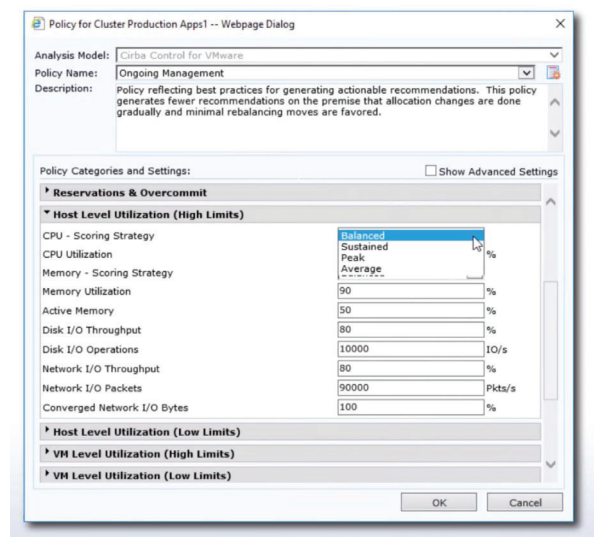
46. Densify.com SaaS service optimizes host placements to consolidate container-based workloads and increase efficiency to reduce the number of required hosts. “By gathering granular container data from frameworks like Prometheus, learning the patterns of activity, and applying sophisticated policies to generate safe recommendations, Densify can produce very precise, automatable recommendations. . . . These recommendations can have a drastic impact on container efficiency. When performed in scale, the Densify analysis will often reduce container request values by over 40%, which has a direct impact on the number of nodes required to host the workload.”³⁵

47. The Densify.com SaaS service meets the “calculating” step of claims 1, 8, and 15. Densify.com SaaS service calculates target resource configurations for VMs based on user-

³⁴ <https://www.densify.com/service/technologies/container-optimization>, last visited Oct. 17, 2019 (Ex. 24).

³⁵ *Id.*

defined policies that “represent the unique requirements in your environment. You configure the amount of risk that corresponds to your business requirements. You also provide details on your organization’s unique business and operational policies so that requirements for SLAs, regulations, disaster recovery, high availability, etc., are reflected, measured and compliance displayed in the console.”³⁶ Policies include target resource allocations, for example, CPU utilization percentage and memory utilization percentage:³⁷



48. Once policies are set, Densify.com SaaS service makes recommendations for optimizing the environment, including for right-sizing and VM placement, which “are derived from policies and operational data to provide IT with unprecedented control over virtual and

³⁶ https://www.densify.com/docs/Content/Control_Console/Understanding_the_Concepts.htm, last visited Oct. 17, 2019 (Ex. 6).

³⁷ Screenshot from video, “Viewing Policy Settings,” at 0:14, available at https://www.densify.com/docs/Content/Reporting_Framework/Viewing_Policy_Settings.htm, last visited Oct. 17, 2019 (Ex. 7) (showing target resource allocation policy settings for a VMware environment).

cloud infrastructure.”³⁸ These recommendations “identify available capacity, risk and optimization and migration opportunities.”³⁹

49. Densify.com SaaS service displays the recommended VM configurations to the user, including recommendations for right-sizing (*i.e.*, target resource configurations):⁴⁰

Environment	Cluster	Guest	Type	From	To	Effective date
London	Internal-Apps	ali-sqr-6112	Memory Allocation	2,948	4,096	June 27, 2016
London	Internal-Apps	ali-sqr-6124	Memory Allocation	10,248	12,288	June 27, 2016
London	Internal-Apps	ali-sqr-61252	CPU Allocation	1	2	June 27, 2016
London	Internal-Apps	ali-sqr-61252	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-sqr-61624	Memory Allocation	32,768	36,864	June 27, 2016
London	Internal-Apps	ali-sqr-61672	Memory Allocation	4,096	8,192	June 27, 2016
London	Internal-Apps	ali-sqr-61694	Memory Allocation	8,192	12,288	June 27, 2016
London	Internal-Apps	ali-sqr-6552	Memory Allocation	2,948	4,096	June 27, 2016
London	Internal-Apps	ali-sqr-6552	Memory Allocation	2,948	4,096	June 27, 2016
London	Internal-Apps	ali-sqr-6568	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-sqr-6568	Memory Allocation	1,024	2,048	June 27, 2016
London	Internal-Apps	ali-sqr-6528	Memory Allocation	4,096	8,192	June 27, 2016
London	Internal-Apps	ali-sqr-6552	CPU Allocation	2	3	June 27, 2016
London	Internal-Apps	ali-sqr-6552	CPU Reservation	0.2	0.3	June 27, 2016
London	Internal-Apps	ali-sqr-6552	Memory Allocation	11,264	16,384	June 27, 2016
London	Internal-Apps	ali-sqr-6796	CPU Allocation	1	2	June 27, 2016
London	Internal-Apps	ali-sqr-6796	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-sqr-6552	Memory Allocation	4,096	8,192	June 27, 2016
London	Internal-Apps	ali-sqr-6588	CPU Reservation	0.1	0.2	June 27, 2016
London	Internal-Apps	ali-sqr-6584	CPU Allocation	2	3	June 27, 2016
London	Internal-Apps	ali-sqr-6584	CPU Reservation	0.2	0.3	June 27, 2016
London	Internal-Apps	ali-sqr-6584	Memory Allocation	7,168	12,288	June 27, 2016

Similarly, Densify.com SaaS service customers review “Guest Sizing Accuracy” in reports regarding their virtual computing environments for additional recommendations on right-sizing CPU and memory on virtual machines and hosts:⁴¹

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https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8).

³⁹ <https://www.densify.com/wp-content/uploads/densify-datasheet-saas-model.pdf>, last visited Oct. 17, 2019 (Ex. 13); *see also* <https://www.densify.com/service/on-premises>, last visited Oct. 17, 2019 (Ex. 14) (“Capacity Control & Visibility: See what you have, what’s coming and exactly what you need—now and in the future”).

⁴⁰ *Screenshot from video*, “De-Risk Report Overview,” at 6:21, *available at* https://www.densify.com/docs/Content/Reporting_Framework/De-Risking_Your_Environment.htm, last visited Oct. 17, 2019 (Ex. 15).

⁴¹ *Screenshot from video*, “Guest Sizing Accuracy Reports,” at 2:34, *available at* https://www.densify.com/docs/Content/Densify_Com/Guest_Sizing_Accuracy_Reports.htm, last visited Oct. 18, 2019 (Ex. 16).

Densify

ANALYSIS FINDINGS

EXECUTIVE SUMMARY

PUBLIC CLOUD OPTIMIZATION

Virtual Optimization

Container Optimization

Billing Analysis

My Reports

SUPPLY & DEMAND PLANNING

TRANSFORM TO CLOUD

ROUTE AND RESERVE DEMAND

PLAN AND MANAGE SUPPLY

FORECAST

AUTOMATION

Real-Time Automation

Proactive Automation

ADVANCED CONTROLS

Optimization Policies

Control Console

Configure My Reports

Guest Sizing Accuracy for Total Estate Set Date

Summary

Allocation Breakdown

Cluster Details

System Details

Environment	Cluster	Cluster Type	Hosted VMs	Unallocated VMs	CPU Allocation (vCPU)			Memory Allocation (GB)			Data Allocation (GB)			Non-compliance
					CPU Utilization	Capacity	Reserve	Capacity	Reserve	Reserve	Capacity	Reserve	Reserve	
London	SA-Apps	122	28	83	11	282	8	0	218	1,188	45	0	1,235	28
London	EC-Apps	79	0	79	1	188	6	0	114	484	6	0	410	13
London	Internal-Apps	67	38	36	13	258	4	0	262	1,372	38	0	1,411	32
New York	EngDev	63	1	33	29	131	2	29	104	298	4	9	253	34
New York	General Apps	68	11	40	17	244	3	29	218	521	30	0	543	27
New York	Production App1	87	1	66	20	227	2	12	217	487	7	3	471	19
New York	Production App2	58	2	28	28	172	2	84	190	390	3	8	395	37
Toronto	Gen Apps	75	5	34	35	188	2	83	129	498	4	6	405	37
Toronto	Info-App1	74	3	57	14	243	0	13	227	511	9	9	511	17
Toronto	Info-App2	47	2	40	5	165	3	0	168	395	7	0	382	7
Toronto	ProdCloud-App1	48	0	26	22	150	1	27	124	485	9	48	440	22
Total		714	58	387	169	2,087	33	227	1,882	6,478	152,908	82,508	6,478	283

Insights

Insights are classified by the **Hosted/Unallocated** VMs requirement for an environment (CPU or memory or data) is less than the existing allocation. VMs are classified to be **Overused** if the system is not at risk and the requirement for any more resources (CPU or memory or data) is less than the existing allocation. VMs systems in these clusters are now classified as both **Underused** and **Overused**.

50. The Densify.com SaaS service meets the “adding resources” step of claims 1, 8, and 15. As noted above, Densify.com SaaS service calculates recommendations for target resource calculations, which include right-sizing (*i.e.*, removing or adding resources to VMs). Densify.com SaaS service transmits instructions for removing or adding resources to VMs to hosts running vSphere ESXi as their hypervisor through Densify Connectors. “Densify Connector, via a PowerShell script connects to the vCenter Server and using standard VMware CLI calls, applies the recommendations.”⁴² Densify.com SaaS service’s Real-Time Automation feature “allows you to configure alarms that trigger recommendations to allocate resources during daily operation to address performance issues during the day. This mode of automation also addresses situations where Proactive automation cannot execute the required recommendations.”⁴³ Additionally, Densify.com SaaS service utilizes “Hot Add” functionality

⁴² https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5); *see also* Press Release, “Cirba Adds Intelligence to VMware® vSphere® DRS to Combine Software-Defined Control with Real Time Response,” (Aug. 27, 2015) *available at* <https://www.densify.com/company/news/releases/20150827-vmware-vsphere-drs-software-defined-control-real-time-response> (Ex. 20).

⁴³ https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Overview.htm, last visited Oct. 17, 2019 (Ex. 25).

in VMware environments “[w]hen automating Densify re-sizing recommendations (bump ups), CPU and/or memory.”⁴⁴

51. The Densify.com SaaS service meets the “VM allocating” step of claims 1, 8, and 15. Densify.com SaaS service “identifies deficiencies in your environment. Deficiencies occur when the current state of a host, VM or sensor-managed resource does not match the associated policy. Recommendations such as . . . rebalancing workloads to reduce risk, or placing booked workloads that are coming online, are listed in the Spectrum Details pane. The recommendations can be automatically pushed to third party systems such as VMware® vCenter™.”⁴⁵ As noted above, Densify.com SaaS service employs Densify Connector to transmit instructions for provisioning VMs to vCenter Servers in the customer’s virtual or cloud computing environment. “Proactive automation allows you to execute the recommendations resulting from your Densify analyses, thus maintaining your environments at optimal efficiency. The analysis refreshes are performed nightly and recommendations are generated and executed overnight based on policy settings, including software license optimization, if implemented. With Proactive Automation enabled, your environment should be optimized overnight and be ready to efficiently host workloads during the day.”⁴⁶ Densify.com SaaS service accomplishes these optimizations using vMotion to place VMs.⁴⁷

⁴⁴ https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Prerequisites.htm, last visited Oct. 17, 2019 (Ex. 26).

⁴⁵ https://www.densify.com/docs/Content/Control_Console/Understanding_the_Concepts.htm, last visited Oct. 17, 2019 (Ex. 6).

⁴⁶ https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Overview.htm, last visited Oct. 17, 2019 (Ex. 25).

⁴⁷ https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Prerequisites.htm, last visited Oct. 17, 2019 (Ex. 26) (“When automating Densify rebalance recommendations, vMotion must be enabled on all the hosts in a cluster. This includes hosts, on which the VMs are currently running and the hosts to which the VMs may be moved.”).

52. The Densify.com SaaS service meets the “container allocation” step of claims 1, 8, and 15. “Densify’s workload sizing and stacking capabilities enable it to learn the utilization patterns of your containers and their pods and determine the optimal request and limit values to ensure that the pods get their required resources, while enabling the containers to run at higher utilization.”⁴⁸ “Once the container resource allocations are aligned with actual consumption, Densify will also optimize the nodes the containers are running on in order to make sure the underlying resources are consistent with workload demands. This process is supported for both on-prem nodes as well as cloud-based deployments.”⁴⁹

53. Densify.com SaaS service allocates containers to virtual machines based on resource configurations of the virtual machines and resource requirements of the containers: “Because on-prem nodes are not as elastic as cloud infrastructure, the focus is typically to ensure there is sufficient capacity to meet peak requirements, and if the nodes are virtual machines, to ensure the container workloads are optimized within the broader context, providing the optimal workload density. In this context, Densify is able to analyze several critical factors that impact container operation:

- Cumulative resource allocations
- Actual utilization and contention probability
- Service tiering and fit-for-purpose clusters
- Managing overlapping quotas (“double overcommit”)⁵⁰

⁴⁸ https://www.densify.com/docs/Content/Densify_Com/Optimizing_Your_Containers.htm, last visited Oct. 17, 2019 (Ex. 27).

⁴⁹ <https://www.densify.com/service/technologies/container-optimization>, last visited Oct. 17, 2019 (Ex. 24).

⁵⁰ *Id.*

54. Accordingly, the Densify.com SaaS service directly infringes at least claims 1, 8, and 15 of the '945 patent.

55. Cirba has known of the '945 patent at least since VMware filed this Complaint.

56. Cirba has actively encouraged and instructed, is actively encouraging and instructing, and will continue to actively encourage and instruct its customers and users to use the Densify.com SaaS service to manage their VMware data centers and containers in a manner that practices at least claims 1, 8, and 15 of the '945 patent. Cirba's technical and marketing materials (including videos) on the Internet, cited above, memorialize this active encouragement and instruction. For example, the datasheet entitled "How our SaaS model works" instructs customers how to use the Densify.com SaaS service to collect data from, and automatically optimize, their cloud-based virtual VMware data centers in the manner described above.⁵¹

57. Cirba's past, present, and future acts of encouraging and instructing customers and users to use the Densify.com SaaS service to manage their cloud-based virtual VMware data centers has induced, induces, and will continue to induce their practice of at least claims 1, 8, and 15 of the '945 patent.

IV. THE '638 PATENT AND CIRBA'S INFRINGING TECHNOLOGY

58. VMware is the owner of all right, title, and interest in and to the '638 patent. The '638 patent was issued on July 17, 2018, and is entitled "Multiple-cloud-computing-facility aggregation." VMware attaches a copy of the '638 patent as Exhibit 3. The claims of the '638 patent cover methods for managing resources across multiple distinct cloud computing environments and virtual data centers.

⁵¹ <https://www.densify.com/wp-content/uploads/densify-datasheet-saas-model.pdf>, last visited Oct. 17, 2019 (Ex. 13).

59. The '638 patent describes technological improvements in the management and operation of multiple cloud-based virtual computing environments like virtual data centers. The '638 patent explains that “the emergence of cloud computing services can provide abstract interfaces to enormous collections of geographically dispersed data centers, allowing computational service providers to develop and deploy complex Internet-based services that execute on tens or hundreds of physical servers through abstract cloud-computing interfaces.” ('638 patent at 1:65-2:3.) Such complex Internet-based services include “[m]ulti-cloud aggregations, cloud-computing services, virtual-machine containers and virtual machines, [and] communications interfaces.” ('638 patent at 4:6-8.) System administrators “can, in either the case of a private cloud 304 or public cloud 312, configure virtual computer systems [*i.e.*, virtual machines] and even entire virtual data centers [*e.g.*, vCenter Servers and associated virtual hosts] and launch execution of application programs on the virtual computer systems and virtual data centers in order to carry out any of many different types of computational tasks.” ('638 patent at 5:33-38.)

60. Claim 10 of the '638 patent recites a “method that configures and manages a multiple cloud-computing-facility aggregation.” The steps of the claimed method are:

- “deploying a cloud-connector server that provides an electronic cloud-aggregation management interface within one of the multiple, operationally distinct cloud-computing facilities”;
- “deploying, registering, and configuring a multiple cloud-connector node in a virtual data center management server, cloud director, or management system within each virtual data center and organization virtual data center in each cloud-computing facility of the multiple cloud-computing-facility aggregation, each cloud-connector

node providing an electronic interface through which the cloud-connector server accesses services provided by the cloud-connector node and that each accesses a cloud-management interface within the cloud-computing facility in which the cloud-connector node is installed through which the cloud-connector node accesses local cloud-management services on behalf of the cloud-connector server”; and

- “invoking distributed management operations through the electronic cloud-aggregation management interface to configure and control operation of the multiple cloud-computing-facility aggregation.”

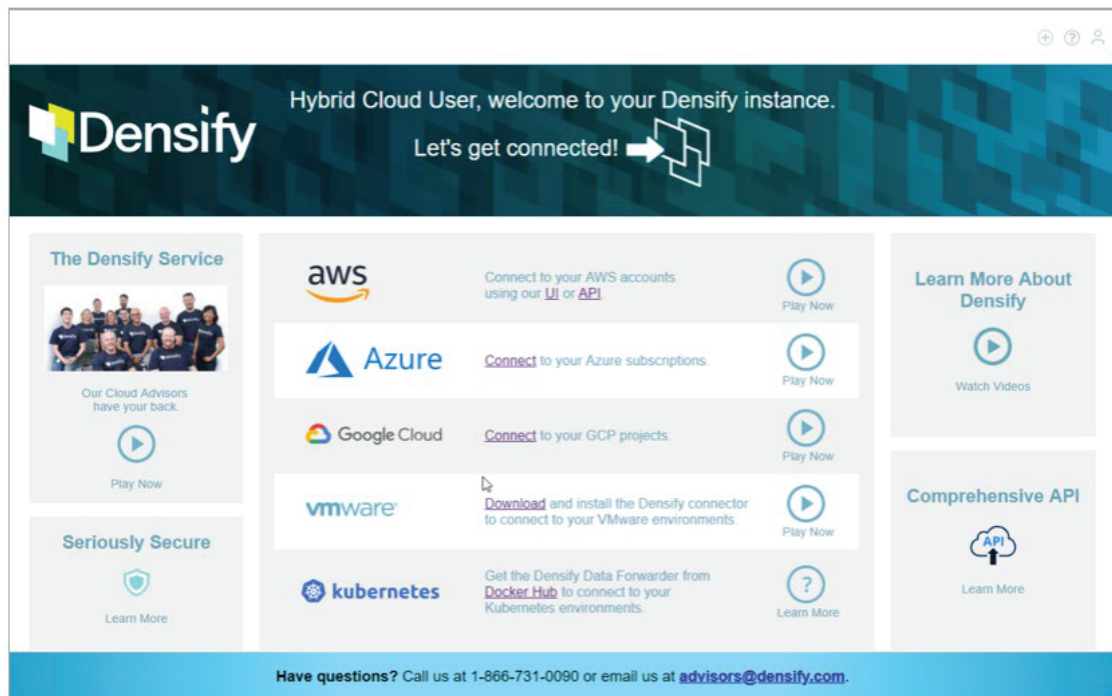
61. Claim 19 of the ’638 patent recites a “data-storage device that stores computer instructions that encode a method that configures and manages a multiple cloud-computing-facility aggregation, the method” corresponding to the steps of claim 10.

62. The Densify.com SaaS service practices at least claims 10 and 19 of the ’638 patent when the service is used to configure and manage multiple distinct cloud computing environments using, for example, its “Real-Time Automation” and “Proactive Automation” features. In such cases, these cloud computing environments are used to maintain virtual data centers running, for example, a virtual vCenter Server instance to manage virtual machines run within the cloud computing environment.

63. The Densify.com SaaS service meets the “server deploying” step of claims 10 and 19. Each Densify.com SaaS service customer is provided its own unique service instance (*i.e.*, a cloud-connector server) for managing its cloud computing environment.⁵² The Densify.com

⁵² https://www.densify.com/docs/Content/Densify_Com/Navigating_Densify.htm, last visited Oct. 17, 2019 (Ex. 28); *see also* https://www.densify.com/docs/Content/Densify_Com/Using_the_Public_Cloud_Connection_Wizard.htm, last visited Oct. 17, 2019 (Ex. 11);

SaaS service instance connects to and manages multiple cloud computing providers, such as AWS, and virtual data center systems, such as VMware:⁵³



The Densify.com SaaS service instance also serves as a management interface for the customer.⁵⁴

64. The Densify.com SaaS service management console provides users with a cloud management user interface:⁵⁵

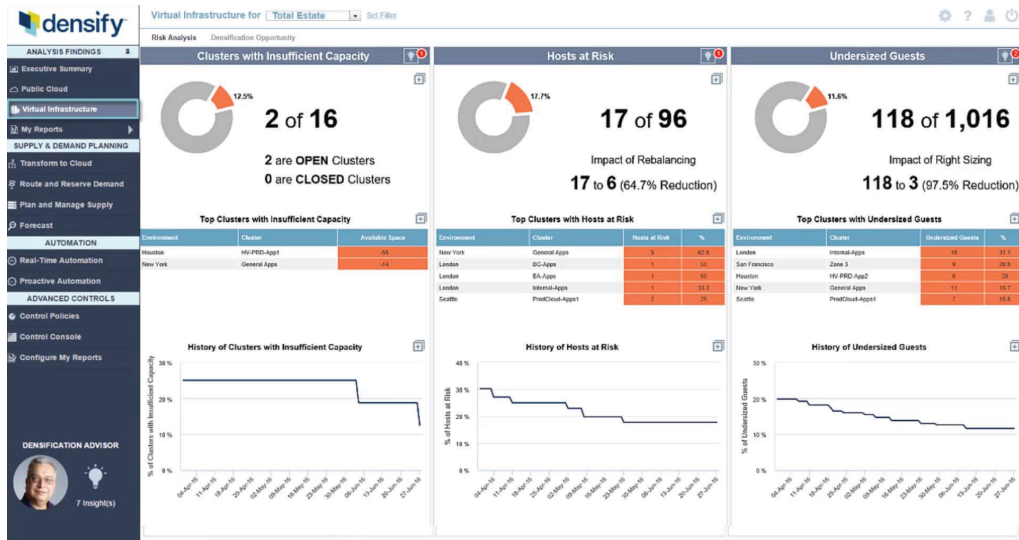
https://www.densify.com/docs/Content/Densify_Com/Data_Collection_VMware_Connector.htm, last visited Oct. 17, 2019 (Ex. 9).

⁵³

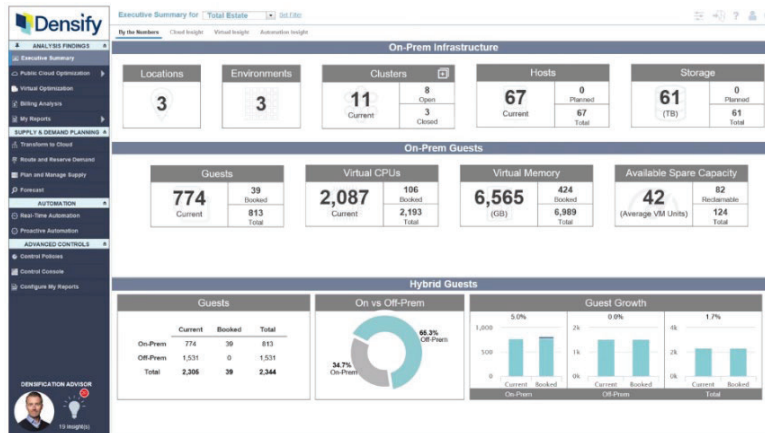
https://www.densify.com/docs/Content/Densify_Com/Navigating_Densify.htm, last visited Oct. 17, 2019 (Ex. 28).

⁵⁴ *Id.*

⁵⁵ Screenshot from video, “De-Risk Report Overview,” at 0:37, available at https://www.densify.com/docs/Content/Reporting_Framework/De-Risking_Your_Environment.htm, last visited Oct. 17, 2019 (Ex. 15).

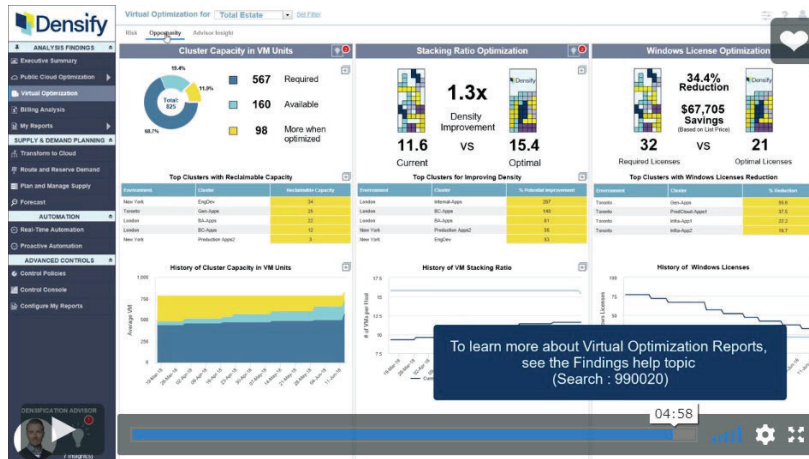


The Densify.com SaaS service management console also provides interfaces for managing virtual data centers operating in the customer's cloud computing environments.⁵⁶



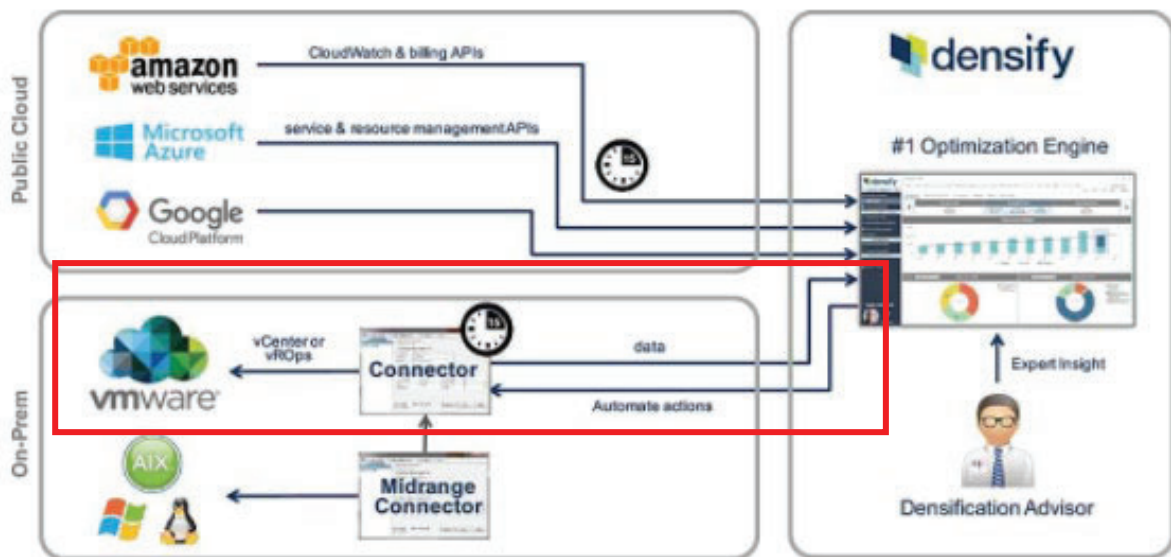
⁵⁶

Screenshots from video, "Installing the Densify Connector," at 4:48 & 4:57, available at https://www.densify.com/docs/Content/Densify_Com/Data_Collection_VMware_Connector.htm, last visited Oct. 17, 2019 (Ex. 9); see also https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8).



65. Upon information and belief, the Densify.com SaaS service is instantiated within the AWS cloud, which it also interfaces with and manages.

66. The Densify.com SaaS service meets the “node deploying” step of claims 10 and 19. Densify.com SaaS service deploys the Densify Connector on each instance of the customer’s vCenter Servers (*i.e.*, within each virtual data center) to manage the user’s cloud-hosted virtual environments.⁵⁷



⁵⁷ <https://www.densify.com/service/saas>, last visited Oct. 18, 2019 (Ex. 29) (annotated).

67. “The Densify Connector . . . allows you to perform automated, scheduled data collection from your vCenter Servers and transfer that data via HTTPS to Densify where data analysis is performed. Optionally you can connect to vRealize Operations (vROps) to obtain historical workload data.”⁵⁸ Densify.com SaaS service also transmits management instructions to hosts running vSphere ESXi as their hypervisor through Densify Connectors. “Densify Connector, via a PowerShell script connects to the vCenter Server and using standard VMware CLI calls, applies the recommendations.”⁵⁹ vCenter Server is a local cloud management service.

68. The Densify.com SaaS service electronically interfaces with each of the customer’s distinct virtual environments via a Densify Connector instance installed within each virtual environment to access utilization statistics and system snapshots and transmit instructions to manage the virtual environment, as detailed above:⁶⁰

⁵⁸

https://www.densify.com/docs/Content/Densify_Com/Data_Collection_VMware_Connector.htm, last visited Oct. 17, 2019 (Ex. 9); *see also*

https://www.densify.com/docs/Content/Performing_Data_Collection.htm (Ex. 10).

⁵⁹ https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5); *see also* Press Release, “Cirba Adds Intelligence to VMware® VSphere® DRS to Combine Software-Defined Control with Real Time Response,” (Aug. 27, 2015) *available at* <https://www.densify.com/company/news/releases/20150827-vmware-vsphere-drs-software-defined-control-real-time-response> (Ex. 20).

⁶⁰ *Screenshot from video*, “De-Risk Report Overview,” at 2:08, *available at* https://www.densify.com/docs/Content/Reporting_Framework/De-Risking_Your_Environment.htm, last visited Oct. 17, 2019 (Ex. 15) (annotation added) (showing distinct virtual environments each managed by the user’s Densify.com SaaS service instance).



Environment	Cluster	Available Space (Average VM)	Primary Constraint
Houston	HV-PRD-App1	-55	CPU Utilization
New York	General Apps	-14	Total CPUs
London	BC-Apps	6	CPU Allocation (Proc Units)
Houston	HV-Gen-App	12	CPU Utilization
London	BA-Apps	13	CPU Allocation (Proc Units)
Seattle	ProdCloud-Apps1	21	CPU Utilization
San Francisco	Zone 1	21	CPU Utilization
New York	Production Apps2	25	CPU Utilization
New York	Production Apps1	30	CPU Utilization
Houston	HV-IntC-App1	35	CPU Utilization
San Francisco	Zone 2	36	CPU Utilization
Seattle	Gen-Apps	42	Memory Utilization in Percent
New York	EngDev	42	Memory Utilization in Percent
Houston	HV-PRD-App2	43	CPU Utilization
London	Internal-Apps	56	CPU Allocation (Proc Units)
San Francisco	Zone 3	62	CPU Utilization

69. The Densify.com SaaS service meets the “invoking” step of claims 10 and 19.

The Densify.com SaaS service manages each of the connected virtual data centers in distinct cloud computing environments via its electronic interface, Densify Connector. The Densify.com SaaS service uses Densify Connectors installed within each virtual data center operating a vCenter Server to transmit management instructions to virtual hosts running vSphere ESXi as their hypervisor. “Densify Connector, via a PowerShell script connects to the vCenter Server and using standard VMware CLI calls, applies the recommendations.”⁶¹

70. Densify.com SaaS service employs its Proactive Automation and Real-Time Automation features to generate management operations for execution by the virtual data center. “Densify provides two types of automation that work together to maintain the efficiency of both your on-premise and/or your hybrid cloud environments. [¶] Proactive [A]utomation allows you

⁶¹ https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5); *see also* Press Release, “Cirba Adds Intelligence to VMware® VSphere® DRS to Combine Software-Defined Control with Real Time Response,” (Aug. 27, 2015) *available at* <https://www.densify.com/company/news/releases/20150827-vmware-vsphere-drs-software-defined-control-real-time-response> (Ex. 20).

to execute the recommendations resulting from your Densify analyses, thus maintaining your environments at optimal efficiency. . . . With Proactive Automation enabled, your environment should be optimized overnight and be ready to efficiently host workloads during the day. . . . Real-Time automation allows you to configure alarms that trigger recommendations to allocate resources during daily operation to address performance issues during the day. This mode of automation also addresses situations where Proactive automation cannot execute the required recommendations.”⁶² “Recommendations such as correctly sizing VMs, rebalancing workloads to reduce risk, or placing booked workloads that are coming online . . . can be automatically pushed to third party systems such as VMware® vCenter™”⁶³

71. Accordingly, the Densify.com SaaS service directly infringes at least claims 10 and 19 of the ’638 patent.

72. Cirba has known of the ’638 patent at least since VMware filed this Complaint.

73. Cirba has actively encouraged and instructed, is actively encouraging and instructing, and will continue to actively encourage and instruct its customers and users to use the Densify.com SaaS service to manage their cloud-based virtual VMware data centers in a manner that practices at least claims 10 and 19 of the ’638 patent. Cirba’s technical and marketing materials (including videos) on the Internet, cited above, memorialize this active encouragement and instruction. For example, the datasheet entitled “How our SaaS model works” instructs customers how to use the Densify.com SaaS service to collect data from, and

⁶² https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Overview.htm, last visited Oct. 17, 2019 (Ex. 25).

⁶³ https://www.densify.com/docs/Content/Control_Console/Understanding_the_Concepts.htm, last visited Oct. 17, 2019 (Ex. 6).

automatically optimize, their cloud-based virtual VMware data centers in the manner described above.⁶⁴

74. Cirba's past, present, and future acts of encouraging and instructing customers and users to use the Densify.com SaaS service to manage their cloud-based virtual VMware data centers has induced, induces, and will continue to induce their practice of at least claims 10 and 19 of the '638 patent.

V. THE '842 PATENT AND CIRBA'S INFRINGING TECHNOLOGY

75. VMware is the owner of all right, title, and interest in and to the '842 patent. The '842 patent was issued on April 16, 2019, and is entitled "System and method for managing a virtualized computing environment." VMware attaches a copy of the '842 patent as Exhibit 4. The claims of the '842 patent cover methods for managing resources in a virtual computing environment.

76. The '842 patent describes technological improvements in the operation of virtual computing environments like data centers, for example, by determining how resource management recommendations will impact the virtual computing environment's current and future states and implementing changes when the impact is above a certain threshold. The '842 patent explains that conventional techniques for resource management "operate in a reactive mode to demand changes" and that "launching VM migrations and/or host power-ons and power-offs while VM demand is increasing can have a negative performance impact on VM workloads." ('842 patent at 1:47-56.)

77. The '842 patent discloses technological solutions addressing the problems of the then-conventional resource allocation techniques, for example, by performing "a cost-benefit

⁶⁴ <https://www.densify.com/wp-content/uploads/densify-datasheet-saas-model.pdf>, last visited Oct. 17, 2019 (Ex. 13).

analysis . . . to determine whether the recommended change would likely result in improved performance.” (’842 patent at 2:1-4.) The ’842 patent teaches “a technique for predictive distributed resource scheduling” that functions “[b]y analyzing the current workload” to “predict future workloads and make recommendations for changes to the virtual computing architecture.” (’842 patent at 10:12-17.) Employing this technique allows performing VM migrations “before available host resources become constrained.” (’842 patent at 10:20-23.)

78. Claim 1 of the ’842 patent recites a “method for managing distributed computing resources in a virtual computing environment.” The steps of the claimed method are:

- “receiving a recommended change to a virtual architecture of the virtual computing environment at a distributed resource scheduling module, wherein the recommended change includes at least one of migrating a virtual machine from one host computer to another host computer, a computer power-on, a host computer power-off, and a migration of a disk image”;
- “determining, by the distributed resource scheduling module, an impact on current workload in the virtual computing environment if the recommended change is performed”;
- “determining, by the distributed resource scheduling module, an impact on future workload in the virtual computing environment if the recommended change is performed”;
- “calculating, by the distributed resource scheduling module, a combined impact on current and future workload from the determined impact on current workload in the virtual computing environment if the recommended change is performed and from the

determined impact on future workload in the virtual computing environment if the recommended change is performed”;

- “determining, by the distributed resource scheduling module, that the combined impact is above a threshold”; and
- “in response to determining that the combined impact on current and future workload is above the threshold, performing the recommended change to the virtual architecture of the virtual computing environment.”

79. Claim 12 of the ’842 patent recites a “non-transitory computer-readable storage medium comprising instructions that, when executed in a computing device, causes the computing device to carry out the steps” corresponding to the steps of claim 1. Claim 12 differs slightly from claim 1 in that the “threshold determining” and “performing” steps additionally specify that if “the combined impact . . . is below the threshold, do not perform the recommended change” and “if the combined impact . . . is above the threshold, perform the recommended change.” If, during the “threshold determining” step of claim 1, it is determined that the combined impact is not above the threshold (*i.e.*, it is below the threshold), then during the “performing” step of claim 1, the recommended change is not performed.

80. Cirba’s Densify.com SaaS service practices at least claims 1 and 12 of the ’842 patent as seen, for example, through the service’s Control Console and Proactive Automation features.⁶⁵ The Densify.com SaaS service uses predictive analytics in combination with its Proactive Automation feature to evaluate the current and future impact of its

⁶⁵

https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8);
https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5).

recommendations and send instructions to vCenter to migrate or move VMs to different hosts through vMotion or to right-size their CPUs or memories through vCenter's hot-add API or other VM configuration APIs.⁶⁶

81. The Densify.com SaaS service meets the "receiving" step of claims 1 and 12. Recommendations from the Densify.com SaaS service include changes such as migrating virtual machines from one host to another. The Control Console feature "provides a useful way of visualizing and managing your virtual environments, giving you control over virtual and cloud infrastructure."⁶⁷ "Proactive Automation allows you to execute the recommendations resulting from your Densify analyses, thus maintaining your environments at optimal efficiency. The analysis refreshes are performed nightly and recommendations are generated and executed overnight based on policy settings, including software license optimization, if implemented. With Proactive Automation enabled, your environment should be optimized overnight and be ready to efficiently host workloads during the day."⁶⁸

82. Densify.com SaaS service customers use the service to "see how well [their] infrastructure is being leveraged, *e.g.*, which workloads and hosts are at risk, which workloads are oversized, and how many hosts are required, based on policies" and "optimize [their]

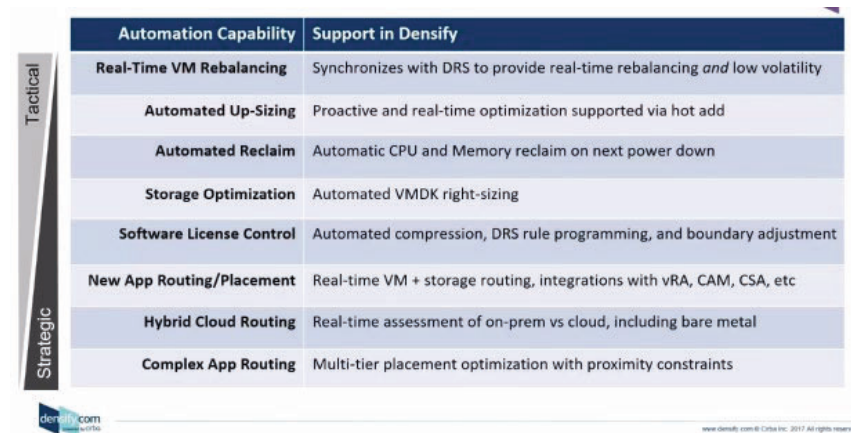
⁶⁶ https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5).

⁶⁷

https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8).

⁶⁸ https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Overview.htm, last visited Oct. 17, 2019 (Ex. 25); *see also* https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5).

environment.”⁶⁹ Densify.com SaaS service then implements recommended changes to optimize a virtual environment, including rebalancing and placing VMs (*i.e.*, migrating a virtual machine from one host computer to another host computer), as shown below.⁷⁰



	Automation Capability	Support in Densify
Tactical	Real-Time VM Rebalancing	Synchronizes with DRS to provide real-time rebalancing <i>and</i> low volatility
	Automated Up-Sizing	Proactive and real-time optimization supported via hot add
	Automated Reclaim	Automatic CPU and Memory reclaim on next power down
	Storage Optimization	Automated VMDK right-sizing
Strategic	Software License Control	Automated compression, DRS rule programming, and boundary adjustment
	New App Routing/Placement	Real-time VM + storage routing, integrations with vRA, CAM, CSA, etc
	Hybrid Cloud Routing	Real-time assessment of on-prem vs cloud, including bare metal
	Complex App Routing	Multi-tier placement optimization with proximity constraints

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83. Furthermore, when describing Cirba’s predictive analysis and Control Console, Andrew Hillier, Cirba’s CTO, provided an exemplary case: “This is a clear case of imbalance. I need to move VMs between these hosts to balance this out . . . [Cirba’s software] will sort all these out and it will do it predictively, so you can tell a policy, that may not have happened yet, that may be at high risk of happening if you look at the patterns of what is running on it . . . based on the VMs that are on this host, you have a high risk of that happening, so we’re going to take care of it before it even happens. . . . We will find a whole lot of stuff that DRS won’t find . . . Even this case, this would probably be a case where that may not have happened yet, we’re just saying the likelihood of it happening based on the model . . . this is a predictive model based on the past, so this might go back . . . through three months and build an envelope of what the

⁶⁹

https://www.densify.com/docs/Content/Control_Console/Working_with_the_Control_Console.htm, last visited Oct. 17, 2019 (Ex. 8).

⁷⁰ *Screenshot from video*, “Densify’s Proactive and Real-time Automation Capabilities,” at 0:50, available at

https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Overview.htm, last visited Oct. 17, 2019 (Ex. 25).

utilization pattern looks like and say ‘yeah, we’re looking like we’re at risk’ Our ‘today’ model is a predictive model.”⁷¹

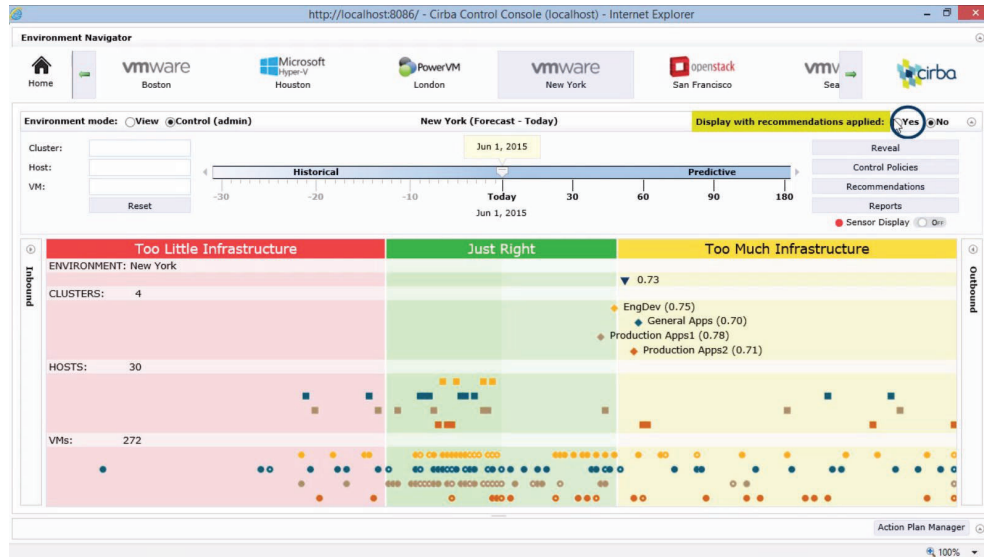
84. The Densify.com SaaS service meets the “current impact determining” step of claims 1 and 12. Densify.com SaaS service determines the current state of a user’s virtual environment and makes recommendations based on user policies. “Densify identifies deficiencies in your environment. Deficiencies occur when the current state of a host, VM or sensor-managed resource does not match the associated policy. Recommendations such as correctly sizing VMs, rebalancing workloads to reduce risk, or placing booked workloads that are coming online, are listed in the Spectrum Details pane.”⁷² Densify.com SaaS service customers use the Control Console and Timeline Slider features to “simulate what the effect of the [recommendations] will be by simply clicking the ‘Display with recommendations applied’ button.”⁷³ The results of the simulation are displayed as shown below, depicting the results of applying recommendations:⁷⁴

⁷¹ “How Cirba Works with Andrew Hillier,” *Vimeo*, at 29:55 (Nov. 18, 2015), *available at* <https://vimeo.com/146181163>.

⁷² https://www.densify.com/docs/Content/Control_Console/Understanding_the_Concepts.htm, last visited Oct. 17, 2019 (Ex. 6).

⁷³ *Video*, “Interpreting the Spectrum,” at 9:10, *available at* https://www.densify.com/docs/Content/Control_Console/Interpreting_the_Spectrum.htm, last visited Oct. 17, 2019 (Ex. 30); *see also* https://www.densify.com/docs/Content/Control_Console/Timeline_Slider.htm, last visited Oct. 17, 2019 (Ex. 31).

⁷⁴ *Snapshots from video*, “Interpreting the Spectrum,” at 9:21-9:30, *available at* https://www.densify.com/docs/Content/Control_Console/Interpreting_the_Spectrum.htm, last visited Oct. 17, 2019 (Ex. 30).



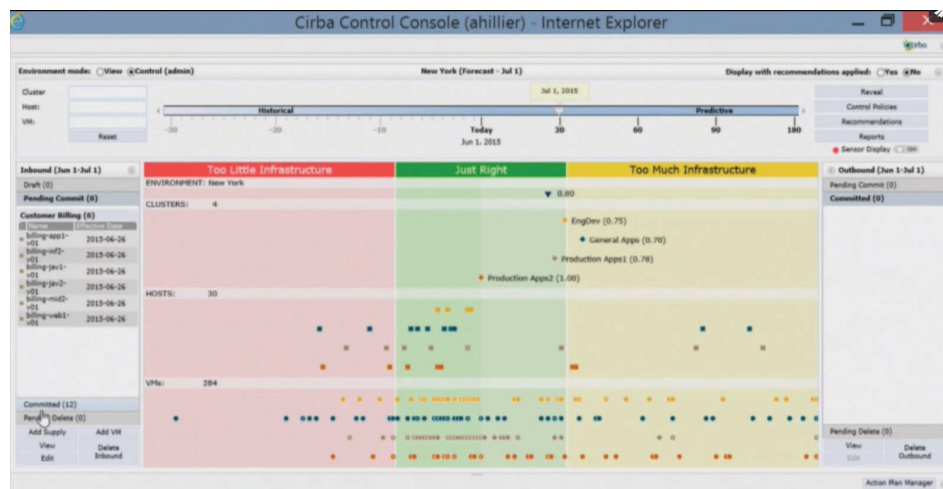
(Before recommendations are applied)



(With simulated recommendations applied)

85. The Densify.com SaaS service meets the “future impact determining” step of claims 1 and 12. Much like Densify.com SaaS service determines the current impact of recommendation implementation, it also determines the future impact of recommendation implementation. The Densify.com SaaS service displays the results of both determinations with the Timeline Slider feature. “The Timeline Slider allows you to select a date in the past or future to see historical or projected data for that environment. The historical timeframe allows you to view the actual state of the environment in the past, while predictive timeframes model trending, growth and include bookings (inbound and outbound) to generate a forecasted view of the

environment.”⁷⁵ “When the slider is moved into the future, the resulting predictive view is calculated using a linear extrapolation of historical data based on policy settings. A policy-specified minimum amount of historical data is needed to calculate predictive views so they are indicative of your environment's growth.”⁷⁶ As Mr. Hillier stated, “I can go forward in time, and if I go forward 30 days ... I'll see apps coming into my environment. So this is where it is a predictive analysis If I go forward in time, I'll see all sorts of inbound and outbound activity . . . this is not just a what-if, this is a living model of the environment. . . . It's a completely predictive model of supply and demand.”⁷⁷



86. The Densify.com SaaS service meets the “calculating” step of claims 1 and 12. Densify.com SaaS service calculates a scoring metric that represents the combined impact on current and future workload determined based on simulated implementation of recommendations as detailed above. For example, Densify.com SaaS service calculates the “Compute Efficiency

⁷⁵ https://www.densify.com/docs/Content/Control_Console/Timeline_Slider.htm, last visited Oct. 17, 2019 (Ex. 31).

⁷⁶ *Id.*

⁷⁷ “How Cirba Works with Andrew Hillier,” *Vimeo*, at 44:17-49 (Nov. 18, 2015), *available at* <https://vimeo.com/146181163>.

Index” or “CEI.”⁷⁸ “CEI reflects the amount of infrastructure required to run the workloads subject to the requirements and specified policies, giving you a true representation of how well infrastructure is being leveraged, given all of the workload requirements and operational and business policies [*i.e.*, with recommendations applied].”⁷⁹ “The value is calculated based on your policy specifications and collected workload data.”⁸⁰ “When the console is in the ‘with recommendations applied mode,’ the CEI measure is calculated based on optimized VM placements and VM allocation recommendations having been applied.”⁸¹ “Considering this concept [CEI] with future-state analysis, it is possible to compute the efficiency index of an environment at a future point in time [*i.e.*, future workload impact] based on trends, capacity reservations and policies.”⁸² Indeed, as Mr. Hillier stated when describing the Timeline Slider feature, “if I go forward in time, I’ll see all sorts of inbound and outbound activity . . . this is not just a what-if, this is a living model of the environment. . . . It’s a completely predictive model of supply and demand.”⁸³

87. The Densify.com SaaS service meets the “threshold determining” step of claims 1 and 12. The Densify.com SaaS service’s Proactive Automation feature automatically “allows you to execute the recommendations resulting from your Densify analyses, thus maintaining

⁷⁸ https://www.densify.com/docs/Content/Concepts/Compute_Efficiency_Index_CEI.htm, last visited Oct. 17, 2019 (Ex. 32).

⁷⁹ *Id.*

⁸⁰ https://www.densify.com/docs/Content/Control_Console/Interpreting_the_Spectrum.htm, last visited Oct. 17, 2019 (Ex. 30).

⁸¹ *Video*, “Understanding the Compute Efficiency Index (CEI),” at 1:00, *available at* https://www.densify.com/docs/Content/Concepts/Compute_Efficiency_Index_CEI.htm, last visited Oct. 17, 2019 (Ex. 32).

⁸² https://www.densify.com/docs/Content/Concepts/Compute_Efficiency_Index_CEI.htm, last visited Oct. 17, 2019 (Ex. 32).

⁸³ “How Cirba Works with Andrew Hillier,” *Vimeo*, at 44:17-49 (Nov. 18, 2015), *available at* <https://vimeo.com/146181163>.

your environments at optimal efficiency. The analysis refreshes are performed nightly and recommendations are generated and executed overnight based on policy settings. . . . With Proactive Automation enabled, your environment should be optimized overnight and be ready to efficiently host workloads during the day.”⁸⁴ For example, a user policy specifies a certain range within which the CEI of their virtual environment should fall.⁸⁵ Similarly, users specify policy thresholds for specific resource utilization metrics, such as specifying that CPU utilization shall not exceed a particular percentage before triggering provisioning of additional resources.⁸⁶

88. The Densify.com SaaS service meets the “performing” step of claims 1 and 12. “Densify identifies deficiencies in your environment. Deficiencies occur when the current state of a host, VM or sensor-managed resource does not match the associated policy. . . . The recommendations can be automatically pushed to third party systems such as VMware® vCenter™ and VMware vCloud™ Director via integration with Densify.”⁸⁷ These recommendations are, for example, configured to bring CEI closer to 1.0 once it exceeds a user-defined threshold for under- or over-provisioning of resources.⁸⁸ Alternately, Densify.com SaaS service automates Cirba’s recommended actions to (a) rebalance VMs (*e.g.*, by requesting that vCenter execute recommended actions using vMotion) and/or (b) right-size VMs (*e.g.*, by

⁸⁴ https://www.densify.com/docs/Content/Densify_Com/Action_Automation_Overview.htm, last visited Oct. 17, 2019 (Ex. 25).

⁸⁵ *Video*, “Understanding the Compute Efficiency Index (CEI),” *available at* https://www.densify.com/docs/Content/Concepts/Compute_Efficiency_Index_CEI.htm, last visited Oct. 17, 2019 (Ex. 32).

⁸⁶ *Video*, “Interpreting the Spectrum,” at 7:00, *available at* https://www.densify.com/docs/Content/Control_Console/Interpreting_the_Spectrum.htm, last visited Oct. 17, 2019 (Ex. 30).

⁸⁷ https://www.densify.com/docs/Content/Control_Console/Understanding_the_Concepts.htm, last visited Oct. 17, 2019 (Ex. 6).

⁸⁸ *See* https://www.densify.com/docs/Content/Concepts/Compute_Efficiency_Index_CEI.htm, last visited Oct. 17, 2019 (Ex. 32).

requesting that vCenter adjust VM CPU and memory usage through “hot add” or other VM configuration options provided by vCenter).⁸⁹

89. Accordingly, the Densify.com SaaS service directly infringes at least claims 1 and 12 of the ’842 patent.

90. Cirba has known of the ’842 patent at least since VMware filed this Complaint.

91. Cirba has actively encouraged and instructed, is actively encouraging and instructing, and will continue to actively encourage and instruct its customers and users to use the Densify.com SaaS service to automatically optimize their VMware data centers in a manner that practices at least claims 1 and 12 of the ’842 patent. Cirba’s technical and marketing materials (including videos) on the Internet, cited above, memorialize this active encouragement and instruction. For example, the datasheet entitled “How our SaaS model works” instructs customers how to use the Densify.com SaaS service to collect data from, and automatically optimize, their VMware data centers in the manner described above.⁹⁰

92. Cirba’s past, present, and future acts of encouraging and instructing customers and users to use the Densify.com SaaS service to collect data from, and automatically optimize, their VMware data centers has induced, induces, and will continue to induce their practice of at least claims 1 and 12 of the ’842 patent.

⁸⁹ See https://www.densify.com/docs/Content/Densify_Com/Using_Proactive_Automation.htm, last visited Oct. 17, 2019 (Ex. 5).

⁹⁰ <https://www.densify.com/wp-content/uploads/densify-datasheet-saas-model.pdf>, last visited Oct. 17, 2019 (Ex. 13).

COUNTS

COUNT 1

(Infringement of the '995 Patent)

93. VMware incorporates by reference each allegation stated in paragraphs 1 through 92 above as if fully stated here.

94. Cirba, Inc. has infringed, infringes, and will continue to infringe one or more claims of the '995 patent, including at least claims 1 and 9, literally or under the doctrine of equivalents, under 35 U.S.C. § 271(a), by making, using, selling, and/or offering for sale in the United States and/or importing into the United States at least the Densify.com SaaS service.

95. Cirba, Inc. has known of the '995 patent at least as of the filing date of this Complaint.

96. Cirba, Inc. actively induces as of the filing date of this Complaint and will continue to actively induce infringement of one or more claims of the '995 patent, including at least claims 1 and 9, under 35 U.S.C. § 271(b), by actively encouraging and instructing and continuing to actively encourage and instruct Cirba, Inc.'s customers and users to practice, as described above, the claims at least through use of the Densify.com SaaS service.

97. Cirba, Inc.'s infringing conduct has caused and is causing irreparable harm to VMware for which VMware has no adequate remedy at law, and such irreparable harm will continue unless and until Cirba, Inc. is enjoined by the Court.

COUNT 2

(Infringement of the '945 Patent)

98. VMware incorporates by reference each allegation stated in paragraphs 1 through 97 above as if fully stated here.

99. Cirba, Inc. has infringed, infringes, and will continue to infringe one or more claims of the '945 patent, including at least claims 1, 8, and 15, literally or under the doctrine of

equivalents, under 35 U.S.C. § 271(a), by making, using, selling, and/or offering for sale in the United States and/or importing into the United States at least the Densify.com SaaS service.

100. Cirba, Inc. has known of the '945 patent at least as of the filing date of this Complaint.

101. Cirba, Inc. actively induces as of the filing date of this Complaint and will continue to actively induce infringement of one or more claims of the '945 patent, including at least claims 1, 8, and 15, under 35 U.S.C. § 271(b), by actively encouraging and instructing and continuing to actively encourage and instruct Densify's customers and users to use at least the Densify.com SaaS service's predictive VM optimization and capacity management features and their automation by transmission of recommended actions to vCenter to practice the claims.

102. Cirba, Inc.'s infringing conduct has caused and is causing irreparable harm to VMware for which VMware has no adequate remedy at law, and such irreparable harm will continue unless and until Cirba, Inc. is enjoined by the Court.

COUNT 3
(Infringement of the '638 Patent)

103. VMware incorporates by reference each allegation stated in paragraphs 1 through 102 above as if fully stated here.

104. Cirba has infringed, infringes, and will continue to infringe one or more claims of the '638 patent, including at least claims 10 and 19, literally or under the doctrine of equivalents, under 35 U.S.C. § 271(a), by making, using, selling, and/or offering for sale in the United States and/or importing into the United States at least the Densify.com SaaS service.

105. Cirba has known of the '638 patent at least as of the filing date of this Complaint.

106. Cirba actively induces as of the filing date of this Complaint and will continue to actively induce infringement of one or more claims of the '638 patent, including at least claims

10 and 19, under 35 U.S.C. § 271(b), by actively encouraging and instructing and continuing to actively encourage and instruct Densify's customers and users to use at least the Densify.com SaaS service's automated public cloud optimization features to practice the claims.

107. Cirba's infringing conduct has caused and is causing irreparable harm to VMware for which VMware has no adequate remedy at law, and such irreparable harm will continue unless and until Cirba is enjoined by the Court.

COUNT 4
(Infringement of the '842 Patent)

108. VMware incorporates by reference each allegation stated in paragraphs 1 through 107 above as if fully stated here.

109. Cirba has infringed, infringes, and will continue to infringe one or more claims of the '842 patent, including at least claims 1 and 12, literally or under the doctrine of equivalents, under 35 U.S.C. § 271(a), by making, using, selling, and/or offering for sale in the United States and/or importing into the United States at least the Densify.com SaaS service.

110. Cirba has known of the '842 patent at least as of the filing date of this Complaint.

111. Cirba actively induces as of the filing date of this Complaint and will continue to actively induce infringement of one or more claims of the '842 patent, including at least claims 1 and 12, under 35 U.S.C. § 271(b), by actively encouraging and instructing and continuing to actively encourage and instruct Densify's customers and users to use at least the Densify.com SaaS service's automated public cloud optimization features to practice the claims.

112. Cirba's infringing conduct has caused and is causing irreparable harm to VMware for which VMware has no adequate remedy at law, and such irreparable harm will continue unless and until Cirba is enjoined by the Court.

PRAYER FOR RELIEF

113. WHEREFORE, VMware prays for judgment as follows:
- A. Enter judgment that Cirba has infringed and is infringing VMware's Asserted Patents;
 - B. Award VMware monetary relief sufficient to compensate VMware for damages resulting from Cirba's infringement of VMware's Asserted Patents, including lost profits and/or a reasonable royalty under 35 U.S.C. § 284 and pre-judgment and post-judgment interest;
 - C. Enjoin Cirba, its officers, agents, servants, and employees, and those persons in active concert or participation with any of them, from commercially manufacturing, using, offering for sale, selling, or importing Cirba's infringing products and services, or inducing the infringement of VMware's Asserted Patents, prior to the expiration date of the last to expire of those patents;
 - D. Award VMware enhanced damages, up to and including trebling of the damages awarded to VMware;
 - E. Award VMware its costs, disbursements, and reasonable attorneys' fees that it incurs in prosecuting this action under 35 U.S.C. § 285; and
 - F. Grant such other and further relief as the Court may deem just and proper.

JURY DEMAND

114. VMware demands a trial by jury on all issues upon which it may have a trial by jury.

Dated: October 21, 2019

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